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## JUVENILE DEMENTIA PARALYTICA

### IV. SYNDROMES OF THE CRANIAL NERVES AND MOTOR SYSTEM

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Previous studies in juvenile dementia paralytica<sup>1</sup> have covered the incidence, sex, age at onset and the family and developmental history. This study is confined to the neurologic syndromes in the disease, including involvement of the cranial nerves, disorders of the motor system and cerebellar disturbances. This study is based on 43 cases personally observed and 610 cases reported in the literature.

In considering the neurologic findings in juvenile dementia paralytica it is important to point out that in the great majority of cases there is an extensive neurosyphilitic process; consequently the neurologic signs in this disease represent a combination of focal brain syphilis, involvement of the spinal cord and dementia paralytica. The resulting picture presents many focal signs, cerebellar as well as cerebral, and manifestations of involvement of the spinal cord, the total of which constitute a picture conspicuously different from dementia paralytica in the acquired (adult) form.

The differential diagnosis from other forms of congenital neurosyphilis rests entirely on the combined mental and neurologic picture rather than on any specific neurologic signs. It is often exceedingly difficult to make a diagnosis when the decision rests between cerebrovascular disease in a feeble-minded person with congenital syphilis or in an epileptic feeble-minded person with juvenile tabes and a juvenile dementia paralytica. As has been pointed out by Ferguson and Critchley,<sup>2</sup> a striking personal or subjective element is involved in arriving at a diagnosis. This is particularly significant in the present study, in which cases have been collected from reports in the literature published over a period of fifty-seven years, beginning with Clouston's<sup>3</sup> in 1877.

From the Menninger Clinic.

1. Menninger, W. C.: Juvenile Dementia Paralytica: I. The Incidence, Sex and Age at Onset, *Am. J. Syph. & Neurol.* **18**:486 (Oct.) 1934; II. Family History, with Special Consideration of Familial Neurosyphilis, *Arch. Int. Med.* **55**:626 (April) 1935. III. The Developmental History, Including Mental and Physical Growth, Trauma and Convulsions, *J. Nerv. & Ment. Dis.* **81**:489 (May) 1935.

2. Ferguson, F. R., and Critchley, M.: A Clinical Study of Congenital Neurosyphilis, *Brit. J. Child. Dis.* **26**:163 (July-Sept.) 1929; **27**:1 (Jan.-March) 1930.

3. Clouston, T. S.: A Case of General Paralysis at the Age of 16, *J. Ment. Sc.* **23**:419, 1877.

The period covers sixty-six years if one credits Mendel's<sup>4</sup> case in 1868. Not only is it difficult to judge adequately the diagnosis in some cases, but in many instances the original observer was reporting a case with some doubt as to the nature of the disease. Nor can even the histologic picture be the final court of appeal, as there occurs a gradual transition from an inflammatory encephalitic reaction, with vascular and meningeal involvement, to a markedly degenerative type of histologic lesion.

The close association of tabetic signs and symptoms with the mental picture of juvenile dementia paralytica is often a confusing factor in the diagnosis. The tabetic form of dementia paralytica, with varying degrees of emphasis on the tabes and the dementia paralytica, occurs frequently, as has been recognized by many writers (Halben,<sup>5</sup> Torkel,<sup>6</sup> Strümpell,<sup>7</sup> Babinski,<sup>8</sup> Köster,<sup>9</sup> Roasenda<sup>10</sup>), although, as Stewart<sup>11</sup> pointed out, lightning pains and gastric crises are practically absent. Juvenile tabes, however, is certainly much less frequent than juvenile dementia paralytica; in tabes optic atrophy and the symptoms in the bladder appear often and early (in 30 per cent of all cases according to Fairbanks<sup>12</sup>), while severe ataxia rarely develops. Schmidt-Kraepelin<sup>13</sup> stated that to her knowledge no case has been described in which the tabes preceded the onset of the dementia paralytica by years, suggesting at least that the latter is primary, with subsequent development of tabetic signs. After reviewing all these cases I can support her in this statement; the great majority of cases of the tabetic form of

4. Mendel, E.: Ueber hereditäre Syphilis in ihrer Einwirkung auf Entwicklung von Geisteskrankheiten, *Arch. f. Psychiat.* **1**:308, 1868.

5. Halben, R.: Infantile Tabes resp. Taboparalyse bei einem 10 jährigen Mädchen, *Deutsche med. Wchnschr.* **35**:1093, 1909.

6. Torkel, K. E. J.: Besteht eine gesetzmässige Verschiedenheit in Verlaufsart und Dauer der progressiven Paralyse nach dem Charakter der begleitenden Rückenmarksaffektion? *Inaug. Dissert.*, Marburg, J. Hamel, 1903.

7. Strümpell, A.: Progressive Paralyse mit Tabes bei einem 13 jährigen Mädchen, *Neurol. Centralbl.* **7**:122, 1888.

8. Babinski, J.: Tabes hérédosyphilitique, *Bull. et mém. Soc. méd. d. hôp. de Paris* **19**:884, 1902.

9. Köster, G.: Zur Klinik und pathologischen Anatomie der Kindertabes bezw. der Taboparalyse des Kindesalters, *Neurol. Centralbl.* **24**:1069, 1905.

10. Roasenda, G.: Un caso di tabo-paralisi giovanile a base eredo-luetica associata ad affezione complicata del cuore e dell'aorta, *Riv. neuropath.* **2**:8, 1908.

11. Stewart, R. M.: Juvenile Types of General Paralysis, *J. Ment. Sc.* **79**:602 (Oct.) 1933.

12. Fairbanks, A. W.: Tabes Dorsalis in Children, in Abt, I. A.: *Pediatrics*, Philadelphia, W. B. Saunders Company, 1925, vol. 7, p. 606.

13. Schmidt-Kraepelin, T.: Ueber die juvenile Paralyse, Berlin, Julius Springer, 1920.



juvenile dementia paralytica are primarily cases of dementia paralytica, with perhaps absence of knee jerks or some other relatively slight indication of involvement of the cord.

#### INVOLVEMENT OF THE CRANIAL NERVES

In table 1 the incidence of involvement of the various cranial nerves is indicated. It should be pointed out that many writers may have failed to mention minor positive findings, and certainly the absence in a report of mention of a particular point does not indicate that the condition was normal. Consequently, the figures showing the incidence of neurologic findings in the 653 cases surveyed must be interpreted as the number of reports in which the point is noted and not as the accurate incidence. The figures represent the minimal percentage that might be expected.

TABLE 1.—*Incidence of Involvement of the Cranial Nerves in Six Hundred and Fifty-Three Cases*

	No. of Cases	Percentage
Optic atrophy.....	82	12.5
Pupillary abnormalities.....	481	73.6
Argyll Robertson.....	149	22.8
Fixed.....	204	31.2
Sluggish.....	128	19.6
Unequal.....	273	41.8
Strabismus.....	48	7.3
Nystagmus.....	42	6.3
Facial paresis.....	66	10.0
Deafness.....	12	2.0
Dysphagia.....	19	2.9
Defect of speech.....	376	57.7
Hypoglossus (deviation of the tongue), based on 80 cases.....	14	

The olfactory nerve was stated to be atrophied in a patient who came to autopsy whose case was reported by van Deventer and Benders,<sup>14</sup> but there are no clinical reports of involvement of this nerve. One patient in my series was reported to have had at one time a defective sense of smell. However, the mental status of the patients precludes such subjective tests in most instances.

*Optic Atrophy.*—In the entire series of 653 cases optic atrophy was reported in 82 (12.5 per cent). In my own series of 43 cases it occurred in 7 instances (16.3 per cent). In Schmidt-Kraepelin's<sup>13</sup> series of 40 cases it occurred 7 times (17.5 per cent). Stöcker<sup>15</sup> reported it in

14. van Deventer, J., and Benders, A. M.: Twee gevallen van dementia paralytica, na de inwerking van een trauma capitis op den leeftyd respectievelijk van 9 en van 11 jaar opgetreden, *Psychiat. en neurol. bl.* 2:118, 1898.

15. Stöcker, W.: Ueber eigenartige Unterschiede im Pupillenbefund bei progressiver Paralyse der Erwachsenen und der juvenilen Form, *Ztschr. f. d. ges. Neurol. u. Psychiat.* 26:564, 1914.

17.5 per cent of the cases observed, Alzheimer<sup>16</sup> in 12 per cent, Dahl<sup>17</sup> in 12 per cent of 166 collected cases, Ferguson and Critchley<sup>2</sup> in 33 per cent and Masten<sup>18</sup> in 25 per cent of 20 cases of congenital neurosyphilis. When these figures are compared with the incidence of optic atrophy in the adult form of dementia paralytica (given by Ferguson and Critchley<sup>2</sup> as from 4 to 5 per cent, by Gudden<sup>19</sup> as 4.9 per cent and by Kraepelin<sup>20</sup> as from 4 to 5 per cent), it is seen that optic atrophy occurs from two and a half to six times as frequently in juvenile dementia paralytica as in the acquired form of the disease.

Optic atrophy in juvenile dementia paralytica seems to be a little slower in developing to complete atrophy than that in the adult, but in some cases it develops rapidly (within six months) even though the patient lives for years afterward. The optic atrophy may occur without other signs of tabes (or involvement of the spinal cord), as it did in 3 of Schmidt-Kraepelin's<sup>13</sup> cases and in 6 of my 7 cases. In a few instances it was the first sign of syphilitic involvement of the nervous system (Weigandt,<sup>21</sup> Köster,<sup>9</sup> and in 2 cases of Bachman<sup>22</sup>). It was one of the first signs of abnormality in case 11 and the first physical symptom.

CASE 11.<sup>23</sup>—A Negro girl was admitted to the hospital at the age of 11 years. Except for a cousin with mental disease, the family was reported to be well; the members were not examined. The patient was the second child. She walked and talked at about 1 year and appeared to be normal until after she was struck by a street-car at 5 years of age. She started to school at 5, but for four years remained in the first grade, the teacher complaining that she was "stupid" and had visual difficulty. Her head began to droop, and she exhibited a little shuffling in her gait. At 10 she was hospitalized for five months without improvement. She returned at 11 years of age.

Physically the patient presented no abnormalities. Neurologically there were a fixation of the left pupil and absence of the light reflex in the right pupil, marked ataxia, a shuffling gait, hyperactive deep reflexes and optic atrophy. The stigmas

16. Alzheimer: Die Frühform der allgemeinen progressiven Paralyse, Allg. Ztschr. f. Psychiat. **52**:533, 1895.

17. Dahl, W.: Ueber jugendliche progressive Paralyse, Inaug. Dissert., Wurtzburg, 1909.

18. Masten, M. G.: Inherited Neurosyphilis, J. Nerv. & Ment. Dis. **70**:379 (Oct.) 1929.

19. Gudden, H.: Zur Aetiologie und Symptomatologie der progressiven Paralyse, mit besonderer Berücksichtigung des Traumas und der im jugendlichen Alter vorkommenden Fälle von Paralyse, Arch. f. Psychiat. **26**:430, 1894.

20. Kraepelin, E.: General Paralysis, Nervous and Mental Disease Monograph Series 14, New York, Nervous & Mental Disease Publishing Company, 1913.

21. Weigandt, W.: Ueber atypische juvenile Paralyse, Neurol. Centralbl. **23**:372, 1904.

22. Bachmann, F.: Progressive Paralyse im Kindesalter, Deutsche med. Wchnschr. **33**:2163, 1907.

23. Ten cases were reported in the previous studies of this series.

were: emaciation and marked pot-belly. She mumbled in a sing-song fashion with a repetition of syllables; she laughed frequently without external stimulus; she was disoriented, mischievous and restless. She was destructive of her clothing and was usually untidy and had to be fed with a spoon.

There was a positive Wassermann reaction of the blood and of the spinal fluid; the fluid contained an increased amount of globulin and 35 cells per cubic millimeter, and the colloidal gold curve was 5555421101. Repeated examinations revealed approximately the same findings.

The child gradually became unresponsive, spending the full period when awake unraveling a stocking which was held close to her face, the head being bowed. Unless given a stocking she unraveled her clothing. The difficulty in gait developed to a steppage type; she was unable to walk without support and finally became bedridden. She made no response to questions except to mumble her name. The menses became irregular at 19, though they had been regular previously. The general physical health was good when she was seen at the age of 21, the duration of the disease then being sixteen years. She was inoculated twice with the organisms of malaria without the development of chills.

*Pupillary Changes.*—Pupillary abnormalities were present, according to the reports, in 481 of the 653 cases (73.6 per cent). This figure is lower, however, than those of any of the personal series recorded: Stöcker,<sup>15</sup> 89 per cent; Schmidt-Kraepelin,<sup>13</sup> 95 per cent; Klauder and Solomon,<sup>24</sup> 95 per cent; Ferguson and Critchley,<sup>2</sup> 94 per cent; Menninger,<sup>25</sup> 90.7 per cent, and, in the collected series, Dahl,<sup>17</sup> 88 per cent, and Fairbanks,<sup>26</sup> 100 per cent in 32 cases in which information was available.

As is shown in table 1, the Argyll Robertson pupillary reaction ("reflex pupillary rigidity") was present in 149 cases (22.8 per cent of 653), a pupil completely fixed both to light and in accommodation in 204 cases (31.2 per cent) and a sluggish reaction to light in 128 cases (19.6 per cent). The important point in these figures is the higher percentage of absolute fixation of the pupils than of Argyll Robertson pupils. It is generally known that in the acquired form of parenchymatous neurosyphilis the Argyll Robertson pupil is more common than absolute fixation; according to Weiler's<sup>27</sup> figures Argyll Robertson pupils are seen in 57 per cent of the cases and absolute fixation in 34 per cent. This higher frequency of total fixation of the pupils was first specially stressed by Stöcker<sup>15</sup> (also by Hussels<sup>28</sup> and Ferguson

24. Klauder, J. V., and Solomon, H. C.: Juvenile Paresis with a Presentation of Twenty-Three Cases, *Am. J. M. Sc.* **166**:545 (Oct.) 1923.

25. Menninger, W. C.: Juvenile Dementia Paralytica, *J. A. M. A.* **95**:1499 (Nov. 15) 1930.

26. Fairbanks, A. W.: General Paresis in Childhood, *J. A. M. A.* **51**:1946 (Dec. 5) 1908.

27. Weiler, K.: Untersuchung der Pupille und der Irisbewegungen beim Menschen, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **2**:101, 1910.

28. Hussels, F.: Beiträge zur Kenntnis der juvenilen Paralyse mit besonderer Berücksichtigung der Augensymptome, *Allg. Ztschr. f. Psychiat.* **73**:555, 1917.

and Critchley<sup>2</sup>), who stressed in addition the frequency of mydriasis in juvenile dementia paralytica (72 per cent in his series) as compared with its frequency in the adult form (21.6 per cent). Easy comparison is shown in table 2.

According to Spielmeyer's view, absolute pupillary rigidity points to disease in the region of the Westphal-Edinger oculomotor nucleus and especially in the centrifugal part of the reflex arc, whereas reflex rigidity (Argyll Robertson) probably depends on the impairment of the centripetal reflex arc between centers of the primary vision and the Westphal-Edinger nucleus. On this basis, Stöcker<sup>15</sup> believed that a nuclear impairment in the quadrigeminal region must show itself more frequently in the juvenile than in the adult form of dementia paralytica. Inequality of pupils was present in 273 cases (41.8 per cent), although

TABLE 2.—Incidence of Argyll Robertson Pupil and Absolute Pupillary Rigidity

Author	No. of Cases	Argyll Robertson Pupil, Percentage	Absolute Pupillary Rigidity, Percentage
Juvenile dementia paralytica			
Dahl <sup>17</sup> (1909).....	98	..	68
Stöcker <sup>15</sup> (1914).....	18	17	67
Schlicht <sup>47</sup> (1915).....	14	30	70
Schmidt-Kraepelin <sup>13</sup> (1930).....	40	30	65
Menninger <sup>28</sup> (1930).....	43	25	44
Menninger: present series.....	653	22.8	31.2
Adult dementia paralytica			
Räcke <sup>30</sup> (1901).....	110	58.2	..
Joffroy <sup>31</sup> (1905).....	227	75	22
Junius and Arndt <sup>29</sup> (1908).....	1,036	55.8	9
Weiler <sup>27</sup> (1910).....	163	57	34

in only 16.3 per cent of my own series. Schmidt-Kraepelin<sup>13</sup> noted it in 60 per cent of her cases, and Stöcker,<sup>15</sup> in 67 per cent of his.

An important point is the occurrence of normal pupils in 29 cases in the entire series (4.4 per cent), which includes 1 case recorded by Klauder and Solomon,<sup>23</sup> 1 by Ferguson and Critchley,<sup>2</sup> and 2 each by Stöcker<sup>15</sup> and Schmidt-Kraepelin<sup>13</sup> and 4 in my own series. Normal pupillary reactions occur in between 5 and 10 per cent of cases of acquired parenchymatous neurosyphilis (Weiler,<sup>26</sup> 9 per cent; Junius and Arndt,<sup>29</sup> 6 per cent; Räcke,<sup>30</sup> 7.3 per cent).

To summarize, pupillary changes in juvenile dementia paralytica are more frequent, there is a much higher percentage of absolute fixation and the pupils are much more frequently dilated than in the acquired type of the disease. This might be explained if one considers

29. Junius, P., and Arndt, M.: Beiträge zur Statistik, Aetiologie, Symptomatologie und pathologischen Anatomie der progressiven Paralyse, Arch. f. Psychiat. **44**:249, 493 and 971, 1908.

30. Räcke: Statistischer Beitrag zur Aetiologie und Symptomatologie der progressiven Paralyse, Arch. f. Psychiat. **35**:547, 1901-1902.

the pupillary response as one of the most sensitive indicators of systemic disorders and particularly of disturbance of the nervous system. Except in local disease of the iris the Argyll Robertson pupil usually precedes absolute fixation, and in cases of congenital syphilis of the brain the damage appears at the time of development and so must be presumed to have existed since birth. As a result one finds a more advanced process at a relatively earlier date than in the acquired form of the disease.

*Strabismus.*—Extra-ocular motor palsy was recorded as present in 48 of the 653 cases, though the frequent occurrence in congenital syphilis makes it questionable how often it may have represented a part of the dementia paralytica process. Fairbanks<sup>26</sup> stated that it was the most frequent type of involvement of the cranial nerves in the disease, although in this series (even granting its relationship to the disease), its incidence was exceeded by that of palsy both of the optic and of the facial nerve. If the recorded cases gave the complete information (as judged by the observations in Schmidt-Kraepelin's<sup>13</sup> and in my own<sup>25</sup> series) the hypoglossal nerve would probably be found to be more frequently involved. Even granting an incidence of oculo-motor palsy in juvenile dementia paralytica of 7.3 per cent, as found in this series, the frequency is much lower than the 17 per cent of 227 cases of acquired dementia paralytica reported by Joffroy.<sup>31</sup>

*Nystagmus.*—Some type of nystagmus was reported in 42 cases (6.3 per cent). Its significance is dubious, although cerebellar involvement in juvenile dementia paralytica is recognized in a small percentage of cases, both clinically and from pathologic evidence.

*Facial Paresis.*—Some degree of facial weakness was reported in 66 cases (10 per cent), making the facial nerve the second most frequently affected cranial nerve (the optic nerve is the one most frequently involved). Ferguson and Critchley<sup>2</sup> stated that it is the nerve most frequently involved. Facial weakness occurred in 11 cases (27.5 per cent) in Schmidt-Kraepelin's<sup>13</sup> series and in 2 of mine. A possible error in this evaluation of its frequency lies in the fact that facial asymmetry is a not uncommon congenital syphilitic stigma and might be interpreted as weakness of the facial nerve on superficial examination.

*Deafness.*—Deafness was reported in only 12 of the entire 653 cases (2 per cent), a smaller incidence than occurs in an average general series of cases of congenital syphilis. It was reported in 18 (4 per cent) of 462 cases of late congenital syphilis (in persons over 13 years of age) studied by Smith.<sup>32</sup> He made the point that it may,

31. Joffroy, A.: Augen bei Paralyse, Neurol. Centralbl. **24**:79, 1905.

32. Smith, F. R., Jr.: Late Congenital Syphilis, Bull. Johns Hopkins Hosp. **53**:231 (Nov.) 1933.

and in fact usually does, occur in the absence of other clinical or serologic evidence of neurosyphilis. Furthermore, it is not possible to determine in how many of these 12 cases of juvenile dementia paralytica the deafness may have been due to disease of the middle ear with repeated inflammatory reactions and in how many it may have been a part of the dementia paralytica process. Certainly it is safe to say that it is rarely part of the process of juvenile dementia paralytica.

*Dysphagia.*—Dysphagia was reported as present in 19 cases in the 653 surveyed. This figure is probably inaccurate and of little significance, since in the terminal stages of the disease the patient usually presents this symptom; consequently its presence in a particular case probably indicates the stage of the disease rather than an early or long-standing involvement of the muscles of swallowing. It may represent a part of the syndrome of bulbar paralysis mentioned by Scripture.<sup>33</sup>

*Disturbance in Speech.*—Some form of this disturbance was reported in 376 cases, representing 57.7 per cent of the entire series of 653 cases. It was present in 153 of Dahl's<sup>17</sup> 159 cases, in all 16 of those studied by Ferguson and Critchley<sup>2</sup> and in more than 50 per cent of Schmidt-Kraepelin's<sup>13</sup> cases. It was present in 32 (74.4 per cent) of my 43 cases. As in the acquired type of the disease, it is one of the most frequently encountered symptoms of the dementia paralytica process.

While the disturbance in speech is primarily cerebral, many of the peculiarities are due to failure in the coordination of the muscles of speech. As Fairbanks<sup>26</sup> pointed out, the slowing and hesitation may be due to the use of indirect paths in the brain between the auditory and visual memory centers and the motor centers of speech necessitated by the destructive progress of the disease. Sometimes preceding or during speech there is overaction of the facial muscles, with jerking of the tongue, tremor of the facial muscles and resulting explosive syllables.

Speech may be altered even during the prodromal period; this fact was stressed by Schmidt-Kraepelin<sup>13</sup> when she described the speech as "frequently strangely toneless, hasty, precipitous, and devoid of every modulation." This was noted also by Eisath.<sup>34</sup> In addition to these changes, the speech at first becomes more simple, is a little slower than previously and has a monotonous intonation. The patient often seems to talk through his teeth, and sometimes there develops a nasal twang to his pronunciation. As the disease progresses he speaks more jerkily, often explosively and with inappropriate inflection in certain parts of

33. Scripture, E. W.: Demonstration of Speech Inscriptions from a Case of Juvenile General Paralysis with Hypopituitarism, *Proc. Roy. Soc. Med. (Sect. Dis. Child.)* 10:10, 1916.

34. Eisath, G.: Frühform der Dementia paralytica, *Neurol. Centralbl.* 24:78, 1905.



speech. He may lisp or stammer and in a later stage elide or transpose, with rhythmic repetition of the end-syllables of words. The speech reaches an incomprehensible state of jumbled syllables, suggesting aphasia. Finally speech becomes less, replies are withheld, and noises or outcries replace words until a state of mutism is reached. Transitory attacks of aphasia, which occur frequently in adult dementia paralytica (Kraepelin<sup>20</sup>), also occur in juvenile dementia paralytica (Scripture,<sup>33</sup> Toulouse and Marchand,<sup>35</sup> Marchand and Novet,<sup>36</sup> Semper,<sup>37</sup> Jeans and Cooke,<sup>38</sup> Hochsinger<sup>39</sup> and Parhon and Urechia<sup>40</sup>), but they must be distinguished from pronounced dysarthria.

One must regard the defect in speech as an extremely common and important symptom in juvenile dementia paralytica, differing slightly perhaps from that in the adult form because of its earlier development and its consequent more pronounced degree. It shows essentially the same quantitative and qualitative defects as in the acquired type, which were described so excellently by Trömmner<sup>41</sup> forty years ago.

*Deviation of the Tongue.*—Involvement of the hypoglossal nerve, as indicated by deviation of the tongue, was present in 7 cases in my series and in 7 cases of Schmidt-Kraepelin's<sup>13</sup> series. This symptom was relatively so frequent in these two series that it undoubtedly occurred in a similarly large percentage of the entire group. At the beginning of this study I may have failed to make notation of this point if it was mentioned. But the fact remains that in a comparatively large number of reports more recently reviewed there is mention of the deviation of the tongue in only 1 case.

*Multiple Lesions of Cranial Nerves.*—If one includes disorders of speech, pupillary disturbances and nystagmus as manifestations of involvement of cranial nerves along with definite involvement of the cranial nerves it is correct to state that multiple lesions of cranial nerves are the rule in juvenile dementia paralytica. Even without including these, there are 25 cases recorded in which two cranial nerves were

35. Toulouse, E., and Marchand, L.: *Démence précoce par paralysie générale*, Rev. de psychiat. **4**:1, 1901.

36. Marchand, L., and Novet, H.: *Paralysie générale infantile chez une imbécile épileptique*, Bull. et mém. Soc. méd. d. hôp. de Paris **25**:110, 1908.

37. Semper, M.: *Les enfants des paralytiques généraux*, Thèse de Paris, no. 54, 1904.

38. Jeans, P. C., and Cooke, J. V.: *Prepubescent Syphilis*, New York, D. Appleton & Company, 1930, p. 203.

39. Hochsinger: *Report of a Case*, Arch. f. Dermat. u. Syph. **48**:408, 1899.

40. Parhon, C., and Urechia, C.: *Sur un cas de paralysie générale juvénile*, J. de neurol. **16**:401, 1911.

41. Trömmner, E.: *Beitrag zur Kenntnis der Störungen der äusseren Sprache, besonders bei multiple Sklerose und Dementia paralytica*, Arch. f. Psychiat. **28**:190, 1896.

involved and 5 in which three nerves were involved, the involvement being distributed as follows:

	No. of Cases
Two cranial nerves involved.....	25
Optic and extra-ocular motor .....	7
Optic and facial .....	8
Optic and auditory .....	3
Optic and hypoglossal .....	2
Extra-ocular motor and facial .....	3
Extra-ocular motor and hypoglossal .....	1
Facial and hypoglossal.....	1
Three cranial nerves involved.....	5
Olfactory, optic and extra-ocular motor.....	1
Optic, extra-ocular motor and facial.....	2
Extra-ocular motor, facial and auditory.....	1
Extra-ocular, auditory and hypoglossal.....	1

In every one of these cases, either pupillary disturbances or defect in speech (or both) was present, and in many of them, nystagmus. The following is an abstract of a report of a case in which the patient showed defective vision, pupillary defects, palsy of the internal rectus muscle, defect in speech, deafness and deviation of the tongue:

CASE 12.—The father of the patient, a girl, aged 14 at the time of examination, was syphilitic, although not neurosyphilitic; the mother gave a negative Wassermann reaction of the blood; two older siblings were not examined but were reported to be well. The patient walked and talked at about 2 years but was always weak. She was mentally retarded and was sent to a special school, where she reached the third grade but showed much difficulty in learning. She played poorly with other children and was quarrelsome, untidy and uncooperative. Recently she had played truant from school to go to motion picture shows.

She had never heard well, had had occasional headache and was chronically constipated. The menses began at 14 years and were apparently normal except that during the preceding three months she had been menstruating for three days every two weeks. She was small of stature and had a marked pot-belly and a badly speckled and greasy skin.

There was 20/50 vision in the right eye and 20/80 vision in the left, without apparent changes in the disks. There was palsy of the right internal rectus muscle and the pupils were very sluggish, with the right pupil larger than the left. Hearing was deficient in both ears, and the tongue deviated consistently to the left. Speech was noticeably lisping and monotonous. The deep reflexes of the right knee and ankle were brisk, but those of the left were not obtained. There was no ataxia, Babinski sign or sensory change. The patient had a flattened nasal ridge, a moderately high palate, bilateral hammer toe, a tendency to webbing of the second and third toes and a small, almost vestigial, fifth toe. She presented a persistent silly grin, and answered even simple questions inadequately and incorrectly. Her fund of knowledge was extremely meager; the mental age was estimated at about 5 or 6 years. There were no psychotic elements in the mental picture.

The Wassermann and Kahn reactions of the blood were negative on two examinations. The spinal fluid showed 13 cells per cubic millimeter, an increased amount of globulin and a 100 per cent Kolmer reaction with 0.4 and 0.6 cc. of fluid. The colloidal gold curve was 0001221000. There was no opportunity for further observation of the patient after examination.

## DISTURBANCES OF THE MOTOR SYSTEM

Disturbances of motor function in some form and degree are nearly always present. In the reports of only 36 of the 653 cases was there no mention of some type of motor abnormality. However, except for 2 cases in my own series, it is not safe to assume that there was no abnormality in the other 34 cases because the report did not mention it.

*Convulsive Attacks.*—These occurred in 197 cases, representing 30.1 per cent of the series of 653 cases. The percentage of incidence, however, does not represent the most conspicuous feature of the attacks, namely the great frequency of occurrence in the same patient. Most writers on juvenile dementia paralytica have stressed the frequency of their occurrence. Kraepelin<sup>20</sup> said that they "seem to be very frequent," and called attention to the probability that many patients with juvenile dementia paralytica are in institutions for persons with epilepsy,

TABLE 3.—Frequency of Occurrence of Common Forms of Disorders of the Motor System

Type	No. of Cases	Percentage
Convulsive attacks.....	197	30.1
Tremor of tongue.....	181	27.7
Tremor of facial muscles.....	107	16.3
Tremor of extended hands.....	168	25.7
Paresis (muscular weakness).....	351	53.7
Ataxia (ineoordination).....	176	26.9
Paralysis.....	126	19.2
Spasticity of muscles.....	77	11.7
Choreiform movements.....	26	3.9
Contractures.....	58	8.9

the condition being diagnosed as "idiocy with epilepsy." Klauder and Solomon<sup>23</sup> stated that such instances are "very frequent," and they were so regarded by Schlicht<sup>42</sup> and Dahl.<sup>17</sup> They occurred in 23 cases (57.5 per cent) of Schmidt-Kraepelin's<sup>13</sup> series and in 14 of my 43 cases (32.5 per cent).

There are several types of attacks, which can be conveniently grouped in four classes: (1) severe epileptic-like convulsive seizures without sequelae; (2) severe epileptic-like seizures with transient or permanent sequelae; (3) focal or jacksonian-like attacks, and (4) attacks which may be regarded as epileptic equivalents. The percentage of incidence of 30.1 per cent in the present survey includes the recording of only the first three types, i. e., those representing only demonstrable clonic muscular seizures.

The first type, namely, the epileptic-like seizures without sequelae, is the predominant type. The attacks are typical of epileptic seizures, with loss of consciousness, clonic spasms of the entire body and a prompt

42. Schlicht, J.: *Casuistische Beiträge zur Lehre von der juvenilen Paralyse*, Inaug. Dissert., Munich, C. Wolf & Sohn, 1915.

return to consciousness after the cessation. They are unusual in that, first, the patient returns to consciousness quickly without any apparent change in his condition and, second, they occur in some cases very frequently. In one of my cases the number of spasms averaged about 30 a day during the last week of life, but Kraepelin<sup>20</sup> reported a case in which there were 458 convulsions during the last week of life and 248 on the last day. The patient in Schlicht's<sup>42</sup> case 7 had 411 convulsions during the last twenty-four hours of life. These are exceptional, although the convulsions characteristically increase in frequency with the development of the disease, unless the patient responds to treatment (which is rare). The majority of patients with this type of convulsive seizure show periodic attacks, the number ranging from one a month to several a week.

The second type of convulsion occurs infrequently: It is the epileptic-like seizure with slow regaining of consciousness and often with residuals of temporary paralysis, clouding of consciousness and marked impairment of all the functions. Marchand and Novet<sup>36</sup> called special attention to this and to the first type of convulsion, regarding the latter as frequent and not serious and the former as infrequent and serious.

The third type, the jacksonian-like focal involvement of a group of muscles, is seen infrequently. It has been recorded in only 14 instances, 6 of which were reported by Schmidt-Kraepelin.<sup>13</sup> Lemei and Giannuli<sup>34</sup> described the convulsions as being facial twitchings. Other instances have been reported by Burzio,<sup>34</sup> Parhon and Urechia,<sup>40</sup> Halban,<sup>5</sup> Schlicht,<sup>42</sup> Long and Landry<sup>34</sup> and Juba.<sup>34</sup> Schmidt-Kraepelin<sup>13</sup> described this type as occurring independently or in connection with generalized seizures and often lasting for a period of hours or days at a time, with retention of consciousness.

The convulsions of the fourth type, which are to be regarded as epileptic equivalents, consist of migrainous attacks, dizzy spells, sudden weakness or fainting, acute disturbances in speech, sudden dulling of consciousness and similar acute changes of a transient character. In my cases these occurred with relative frequency, though they were not of a character to lend themselves to statistical analysis. It is impossible to judge from reports the presence of this kind of periodic attack, and consequently cases in which they appear are not included in the 30.1 per cent of cases in which convulsive seizures were noted. Attacks of dizziness were specially mentioned in cases reported by Kraepelin,<sup>20</sup> Sick,<sup>34</sup> Moyano<sup>34</sup> and Klauder and Solomon.<sup>24</sup>

Epileptic-like seizures occurred in 30.9 per cent of 653 cases of juvenile dementia paralytica. Convulsive seizures occurred in 60 per cent of the cases of adult (acquired) dementia paralytica studied by Heilbronner,<sup>43</sup> in 53.3 per cent of those studied by Junius and Arndt,<sup>29</sup>

43. Heilbronner, K.: Ueber Krankheitsdauer und Todesursachen bei der progressiven Paralyse, *Allg. Ztschr. f. Psychiat.* 51:22, 1894.

in 34.5 per cent of those reported by Räcké,<sup>30</sup> and in from 30 to 40 per cent of those reported by Kraepelin.<sup>20</sup> The convulsions of the juvenile type differ from those of the adult type in their much more frequent occurrence in the particular patient and in the lesser frequency of "paralytic" sequelae.

*Tremors of the Tongue, Facial Muscles and Extended Hands.*—Tremor of the tongue was recorded in 27.7 per cent of the 653 cases, tremor of the facial muscles in 16.3 per cent and tremor of the extended hands in 25.7 per cent. That tremor of the tongue occurs most frequently is supported by the opinion of Schmidt-Kraepelin,<sup>13</sup> although in my 43 cases tremor of the tongue and of the extended hands was present in 32.5 per cent and facial tremors in 25.6 per cent. In my series, the observation of which may indicate more accuracy, the incidence was somewhat higher than in the entire group. Ferguson and Critchley<sup>2</sup> found tremors in 75 per cent of their cases.

The tremor in juvenile dementia paralytica is essentially similar to that seen in adult dementia paralytica. The tongue becomes coarsely tremulous and even very jerky in its movements. The facial tremors at times suggest a jacksonian attack, with marked quivering of the muscles, blinking of the eyes and twitching of the face.

The percentages cited indicate a less frequent occurrence of tremors in the juvenile than in the acquired type as compared with the figures of Räcké,<sup>30</sup> who reported tremor of the tongue in 86.3 per cent and tremor of the hands in 37.2 per cent of 110 cases.

*Paresis (Muscular Weakness).*—A disturbance of motor power, most noticeable in the gait, is the most commonly recorded disturbance of the motor system, occurring in 53.7 per cent of the cases. In my own series it was present in 58.1 per cent; Schmidt-Kraepelin<sup>13</sup> found it in "nearly all cases," and it is frequently referred to as one of the most characteristic features of the disease (Woltär,<sup>44</sup> Moussous<sup>45</sup>).

The muscular weakness is often the first symptom of the disease, being shown as a disturbance in gait even though it may be impossible to demonstrate the weakness when the child is reclining in bed. The gait is slow and hesitating and when, as is frequent, there is associated spasticity, it is stiff and there is a tendency to staggering. Klauder and Solomon<sup>23</sup> called attention to the earlier development of these symptoms in the juvenile than in the adult type of dementia paralytica. Associated with the muscular weakness in a great number of cases are spasticity and ataxia, and the entire picture progresses with a corresponding increase in each of these features. Consequently the presence of paresis,

44. Woltär, O.: Beitrag zur Kasuistik der Paralysis progressiva im Kindesalter, Prag. med. Wchnschr. **30**:538, 1905.

45. Moussous, M.: Paralysie générale juvénile, Gaz. hebdomadaire de médecine et de chirurgie, **27**:595 (Dec. 16) 1906.

as well as the degree of spasticity and ataxia, is indicative of the stage of the disease. In late stages the patient occasionally presents pes equinus, tends to trip on his own feet and shows extreme awkwardness and unsteadiness of gait, often requiring help to walk at all. In the terminal stage the paresis progresses to a state that is essentially paralysis, and the patient becomes bedridden, with resulting spastic contractures.

Apraxia has been recorded in several cases (Claude and Levi-Valenski,<sup>46</sup> Pernambuco<sup>47</sup> and Scripture<sup>33</sup>). In Scripture's<sup>33</sup> case the patient showed not only apraxia but bulbar paralysis. Ferguson and Critchley<sup>2</sup> called attention to a frequent defect in the quality of movements carried out on command; thus, the child may have difficulty in protruding the tongue or in extending the arms, and yet "no ideational apraxia exists as demonstrated by the ability to salute, wave farewell and so on at command." Apraxia was not conclusively demonstrated in any of my cases, and the inherent difficulties of the hypophrenic mental state would make the demonstration of this point questionable in most cases.

*Ataxia (Incoordination).*—A special feature of the motor paresis is ataxia, recorded in 26.9 per cent of the cases, with muscular weakness noted in approximately one half. It was present in 35 per cent of my cases<sup>24</sup> and in 25 per cent of Schmidt-Kraepelin's<sup>13</sup> cases. It is commonly shown in incoordinate movements of the upper extremities and in a jerky clumsy gait and usually can be demonstrated by the finger-to-nose and heel-to-knee tests. Stewart<sup>11</sup> made the statement that this symptom is more often an indication of cerebellar degeneration than of involvement of the posterior columns, with which I agree. It is characteristically difficult and often impossible for the patients to make rapid alternating movements, as in pronation and supination or opening and closing the hands. Further, nystagmus is common; perhaps most important is the consistent frequency of pathologic evidence of cerebellar degeneration.

*Paralysis.*—Paralysis or unilateral marked paresis of one or more extremities (to be regarded as a residual paralysis) was recorded in 126 cases (19.2 per cent). Hemiplegia was evident in 5 of my cases and tetraplegia in 1. "Lameness of one side" was present in 5 of Schmidt-Kraepelin's cases.

The etiologic factor of congenital syphilis in Little's disease is considerable (Ferguson and Critchley<sup>2</sup>), and has been reported in many cases. It is rather common to find a history of transient hemiplegia in juvenile dementia paralytica as illustrated in case 13.

46. Claude, H., and Levi-Valenski: Paralyse générale juvénile, hérédité syphilitique: Symptômes apraxiques, *Rev. neurol.* **16**:1180, 1908.

47. Pernambuco, P.: Sobre um caso de paralyia geral juvenil, *Arch. brasil. de med.* (supp. 3) **2**:246, 1912.



CASE 13.—A youth, aged 17 on admission, was the second child of the father's second marriage. Four younger children were well, the two following the patient having a negative Wassermann reaction of the blood. The father had a positive Wassermann reaction and the mother a negative reaction in two tests. The patient's birth and early development were said to have been normal; he finished the sixth grade at 14 years of age. At 13 he became "droopy" and failed in his studies. At 14 he began to talk "funny" and was "thick-tongued." A month later there developed marked "weakness" of the left side of the face, of the left arm and of the left leg, and the condition was diagnosed as brain tumor. At the age of 15 the diagnosis of dementia paralytica was made, and inoculations with typhoid vaccine were given. No change occurred, though the hemiplegia gradually improved. At 16 the patient was hospitalized and was given malaria therapy, but the left side drooped more and speech became almost unintelligible. At 17 he was again hospitalized.

Physically, the patient was underdeveloped (height, 5 feet and 4 inches [162 cm.], weight, 111 pounds [50.3 Kg.]); he had a female distribution of genital hair but normally developed genitals.

Neurologically, there were: shuffling, unsteady steppage gait; residuals of left hemiparalysis; marked spasticity and ataxia, and dilated, unequal, fixed pupils. The ocular fundi were normal. The tongue was protruded to the right. The reflexes were greatly increased. The Babinski sign was absent bilaterally. Stigmas were: prominent frontal bosses, markedly deformed teeth and small deep set eyes. Mentally, the boy was friendly and attempted to cooperate, but he said no words clearly. He carried out simple commands and cared for himself, although he had difficulty in lacing his shoes.

The spinal fluid contained 19 cells; the Wassermann reaction was positive, and the colloidal gold curve was 555542220. The Wassermann reaction of the blood was positive.

A second course of malaria therapy was given, making three series of chills. No clinical improvement was noted, though the Kolmer and Kahn reactions of the blood became negative. The Kolmer reaction of the spinal fluid was positive in 1 cc. of fluid; the cell count was 2, and the colloidal gold curve was 2222221000.

One must make the distinction in cases with paralysis between the very late stage, when the paresis becomes so marked in all the extremities as to present a picture of tetraplegia, and similar cases in which there is a definite cerebral vascular accident. The former condition often appears in the terminal stage.

*Spasticity.*—Spasticity of the muscles was reported in only 77 instances, or in 11.7 per cent of the 653 cases. This is probably far below the actual incidence as judged by its frequency in 34.8 per cent of my cases and in "more than half" of Schmidt-Kraepelin's.<sup>13</sup> Alzheimer<sup>16</sup> stated that it is "characteristic" of the disease. Further, it was present in all of my patients who had paralysis, and it seems likely that it was present at least in the majority of cases reported in which there was paralysis (126). In many cases spasticity is not marked, though it is demonstrable, and it accounts in part for the jerky, irregular movements so often observed.

*Choreiform Movements.*—Choreiform movements were recorded in 26 cases, or 3.9 per cent of the 653 cases. They were specially mentioned, however, by Arsimoles and Halberstadt,<sup>48</sup> Ferguson and Critchley<sup>2</sup> and Stewart,<sup>11</sup> and Schmidt-Kraepelin<sup>13</sup> observed them in about one fourth of her patients. These movements, as well as the terminal contractures, were attributed by Stöcker<sup>15</sup> to severe inflamma-

Maude Stewart  
October 19 1929  
This is a bright  
sunny day  
I wish to go home  
I have been here 16 years and  
10 months

A specimen of writing of a patient with juvenile dementia paralytica. The phrases dictated to the patient, who received no assistance with the spelling, were: "Maude Stewart—October 19, 1929—This is a bright sunny day. I wish to go home—I have been here sixteen years and ten months." Note the elision of "to" and "have."

tory reactions in the basal ganglia and in the optic thalamus, which were observed by Alzheimer.<sup>16</sup>

Restlessness, while not necessarily of a choreic or athetoid type, is very common in juvenile dementia paralytica. The patients have periods during which hyperactivity is conspicuous; at other times there is almost

48. Arsimoles and Halberstadt: La paralysie générale juvénile, Ann. méd.-psychol. **11**:384, 1910; **12**:35 and 239, 1910.

no activity. One patient for months would unravel any kind of cloth furnished to her and her own clothing if nothing was furnished, always in restless activity.

*Contractures.*—While not essentially a disturbance of the motor system, the spasticity and paresis gradually increase in many instances in which death is approaching, causing the bedridden person to assume an intra-uterine position, with flexed extremities and subsequent contractures. These contractures are first established in the legs and then in the arms. This picture was presented in 58 (8.9 per cent) of the recorded group of 653 cases. It must be understood that this almost invariably occurs only in the terminal picture of the disease, and so the percentage here presented has no significance as to its actual incidence.

*Writing.*—Mention should be made of the defects in writing, which are a result of the combination of defective mental processes and the ataxia. They are of essentially the same character as those of acquired dementia paralytica, except that in many cases they are not demonstrable because the patients did not mature sufficiently to learn to write, or did not learn beyond the small childish stage of spelling, with elisions and omissions.

#### CEREBELLAR DISEASE

Statistically it was not possible to tabulate the cases in which there was cerebellar involvement, though the condition was recognized rather frequently. Several writers have pointed out this special feature of the disease (Winkler,<sup>49</sup> Klessens,<sup>50</sup> Dufour,<sup>51</sup> Marie and Hervey<sup>52</sup>). Stewart<sup>11</sup> expressed the belief that much of the ataxia is due to cerebellar degeneration rather than to involvement of the posterior columns of the cord, basing his opinion on both clinical and pathologic studies. Schmidt-Kraepelin<sup>13</sup> observed disturbances of equilibrium and peculiar turning movements which she was inclined to attribute to cerebellar disease.

Repeated pathologic studies have revealed the frequent involvement of the cerebellum, and clinical observation has revealed a fair number of cases in which there was evidence of such disease other than ataxia. Such a condition is illustrated in case 14, in which there was not only marked ataxia (probably of cerebellar origin) but also intention tremor,

49. Winkler, C.: Ein Fall juvenilen Paralyse, *Psychiat. en neurol. bl.* **18**:522, 1914.

50. Klessens, J. J. H. M.: Klinische demonstratie van cerebellaire atwijkingen bij lijders aan juvenile paralyse, *Nederl. tijdschr. v. geneesk.* **1**:345, 1917.

51. Dufour, A.: Sintomatologia atassica, a tipo cerebellare nella paralisi progressiva infanto-juvenilis, *Osp. maggiore* **9**:293, 1921.

52. Marie, A., and Hervey: Trois cas de paralysie générale juvénile, *Encéphale* **23**:346 (April) 1928.

scanning speech, slight hemiatrophy of the entire left side of the body, marked adiadokokinesis and a history of attacks of dizziness.

CASE 14.—A Negro youth, aged 19, whose parents were reported as being well, had an illegitimate sister, aged 23, who had had three miscarriages and had epileptiform convulsions. The patient had a normal birth and developed normally; he attended school from his sixth to his sixteenth year, and reached the sixth grade. The mother kept him from school because he had dizzy spells and fell in the street, though he did not lose consciousness. His legs seemed weak, and at a clinic he was told that something was wrong with his spine. At 18 he became cross, irritable and at times stupid, often laughing without cause. He became seclusive, avoided companions and stayed at home.

Physically, there was enlargement of the postcervical, the epitrochlear, the axillary and the inguinal lymph nodes. There was a systolic murmur at the apex of the heart, transmitted to the axilla. Neurologically there was slight atrophy of the left side of the body. The pupils were of the Argyll Robertson type; there was slight sclerosis of the vessels of the ocular fundi. The patient was unable to pronounce any difficult word; he left out syllables and reduplicated. He was noticeably ataxic. There were some paresis, marked ataxia, coarse tremors of the hands and of the face and marked intention tremor. It was impossible for him to carry out rapid alternating movements, and purposive movements like buttoning a coat were accomplished only with great difficulty. The deep reflexes were much exaggerated; the Romberg sign was positive. The stigmas were slight facial and bodily hemiatrophy. Mentally, he was reasonably well oriented and slightly euphoric but gave an inadequate emotional response. He had no insight, and intellectual tests were poorly performed. He was unable to write his name or to repeat simple stories. There were no delusions.

The Wassermann reaction of the blood and spinal fluid was positive. The spinal fluid contained 260 cells per cubic millimeter and an increased amount of protein; a colloidal gold test was not reported.

The patient was in the hospital for a month, during which time because of his feeble condition he was kept in bed. He was removed in response to a court order.

#### SUMMARY AND CONCLUSIONS

1. The neurologic syndromes encountered in juvenile parenchymatous neurosyphilis are in general more frequent, more diverse and more advanced than those noted in acquired (adult) dementia paralytica. They represent combinations of focal brain syphilis, meningovascular syphilis and involvement of the spinal cord with the diffuse syphilitic encephalitis (dementia paralytica process).
2. Involvement of the spinal cord, indicating a tabetic form of the disease, is present in from 10 to 15 per cent of cases. The disease process begins with cerebral manifestations, and the signs referable to the cord develop subsequently.
3. Atrophy of the optic nerve is present in from 12 to 18 per cent of cases, compared with an incidence of about 5 per cent in cases of the acquired form of the disease.

4. Pupillary abnormalities are present in from 75 to 90 per cent of cases; absolute fixation of the pupil is much more common than the Argyll Robertson pupil, which is again a differentiation from the signs in adult dementia paralytica.

5. Palsy of the muscles of the eye and nystagmus are present in from 5 to 10 per cent of cases.

6. The facial nerve is involved in about 10 per cent of cases. In many cases, however, there is a developmental facial asymmetry which might be confused with a pathologic weakness of the facial nerve.

7. Deafness occurs infrequently (in 2 per cent of cases) and usually does not represent a direct association with the dementia paralytica process. It is frequently present in cases of congenital syphilis in which there is no evidence of involvement of the central nervous system.

8. Dysphagia is occasionally present and in most cases represents a late stage in the disease rather than an isolated bulbar involvement in the early stage.

9. Defects in speech, qualitatively and quantitatively similar to the type observed in adult dementia paralytica, are present in from 50 to 75 per cent of all cases, usually in an early stage.

10. Involvement of the hypoglossal nerve is present in from 10 to 15 per cent of cases.

11. Multiple involvement of the cranial nerves is not infrequent; occasionally even three or four cranial nerves may show disturbed function.

12. Of the disturbances of the motor system paresis is most common, being manifest in more than 50 per cent of cases, most characteristically as a disturbance of gait, with ataxia in 25 per cent of cases.

13. Convulsions or "spells" of some type occur in from 30 to 40 per cent of cases. They are characterized by great frequency; patients may have as many as 400 or more in a day. Often there are epileptiform attacks, occasionally petit mal attacks and occasionally epileptic equivalents.

14. Paralysis, as monoplegia, hemiplegia or tetraplegia, occurs in about 20 per cent of cases, most often with the development of spasticity.

15. The motor activity of the patients with juvenile dementia paralytica is typically one of restlessness, or hyperkinesis, often with choreiform and even athetoid movements.

16. Contractures are common in the terminal stage.

17. Cerebellar disease is frequently conspicuous in the clinical picture, as indicated by ataxia, scanning speech, nystagmus, adiadokokinesis and equilibratory disturbances.

## INSULIN IN CATATONIC STUPOR

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Much experimental work has been done on the administration of insulin to nondiabetic subjects. Bulatao and Carlson<sup>1</sup> noted that the injection of insulin increased the motility of the stomach in the normal fasting dog. They observed also that subsequent injection of dextrose inhibited this motility. Quigley, Johnson and Solomon<sup>2</sup> confirmed these observations and noted an accompanying increase in the sensation of hunger. They concluded that insulin may increase the gastric tone either through a direct action on the gastric mechanism or indirectly through the production of hypoglycemia. This work, the results of which have since been generally confirmed, has established the fact that gastric activity and the level of the blood sugar are intimately associated with the sensation of hunger. Campbell<sup>3</sup> wrote: "In intractable anorexia from various causes, hunger may still be induced with insulin when other measures completely fail." Fonseca and de Carvalho,<sup>4</sup> Okada and his co-workers<sup>5</sup> and Lueders and Watson<sup>6</sup> proved that insulin stimulates the gastric, biliary and pancreatic secretions. Janney and Shapiro<sup>7</sup> found that insulin and dextrose caused additional sparing of protein

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From the wards of the Rockland State Hospital.

Read at the Inter-State Hospital Conference, New York, April 20, 1934.

1. Bulatao, E., and Carlson, A. J.: Contributions to Physiology of Stomach: Influence of Experimental Changes in Blood Sugar Level on Gastric Hunger Contractions, *Am. J. Physiol.* **69**:107 (June) 1924; The Relation of the Blood Sugar to the Gastric Hunger Contractions, *ibid.* **68**:148 (March) 1924.

2. Quigley, J. P.; Johnson, V., and Solomon, E. I.: Action of Insulin on Motility of Gastro-Intestinal Tract; Action on Stomach of Normal Fasting Man, *Am. J. Physiol.* **90**:89 (Sept.) 1929.

3. Campbell, Walter R.: Indications for Use of Insulin, *Canad. M. A. J.* **22**:188 (Feb.) 1930.

4. Fonseca, Fernando, and de Carvalho, Alberto: Sur le mécanisme de l'action de l'insuline sur la sécrétion gastrique, *Compt. rend. Soc. de biol.* **96**:1327 (May 20) 1927.

5. Okada, Seizaburo; Kuramochi, Kwanichi; Tsukahara, Toshio, and Ooinone, Tatsue: Pancreatic Function: IV. The Humoroneural Regulation of the Gastric, Pancreatic and Biliary Secretions, *Arch. Int. Med.* **43**:469 (April) 1929.

6. Lueders, C. W., and Watson, M. E.: The Effect of Insulin Therapy on Pancreatic Enzymes in Malnutrition, *Arch. Int. Med.* **49**:330 (Feb.) 1932.

7. Janney, N. W., and Shapiro, I.: Rôle of Insulin in Protein Metabolism, *Arch. Int. Med.* **38**:96 (July) 1926.



over dextrose only in each of six carefully controlled metabolic experiments on five different persons.

#### EFFECT OF INSULIN IN A VARIETY OF NONDIABETIC CONDITIONS

To Pitfield,<sup>8</sup> an American pediatrician, must go the credit for first using insulin in the treatment of nondiabetic persons. Impressed with the improvement in the nutritional state of diabetic patients following the use of insulin, he applied the knowledge gained through his observation in 1923 in the treatment of a patient with nondiabetic infantile inanition. The patient, who was a dystrophic infant aged 4 months, gained 16 ounces (453.6 Gm.) in as many days on the administration of 1 unit of insulin daily.

Pitfield's work was rapidly followed by that of Marriott<sup>9</sup> with infants and of Barbour<sup>10</sup> with children. Since then much has been written in this field. Tisdall and his co-workers,<sup>11</sup> however, were not convinced that the improvement they noted in infants was due to insulin per se.

In 1925, Falta<sup>12</sup> first used insulin in the treatment of three nondiabetic persons with constitutional asthenia; they gained weight rapidly and maintained the weight even after the omission of the hormone. Although the value of this work was promptly recognized, as attested to by the number of references in the foreign literature, Americans were slower in following Falta's lead. Short<sup>13</sup> commented on this in 1929. His work in this country was followed by that of Metz,<sup>14</sup> Nichol,<sup>15</sup> Barker<sup>16</sup> and Blotner,<sup>17</sup> all of whom reported gain in weight and an increase of general well-being in large series of cases.

8. Pitfield, R. L.: Insulin in Infantile Inanition, New York M. J. **118**:217 (Aug. 15) 1923.

9. Marriott, W. McKim: The Food Requirements of Malnourished Infants with a Note on the Use of Insulin, J. A. M. A. **83**:600 (Aug. 2) 1924.

10. Barbour, D.: Use of Insulin in Undernourished Non-Diabetic Children, Arch. Pediat. **41**:707 (Oct.) 1924.

11. Tisdall, F. F.; Brown, Alan; Drake, T. S. H., and Cody, M. G.: Insulin in Treatment of Malnourished Infants, Am. J. Dis. Child. **30**:10 (July) 1925.

12. Falta, W.: Ueber Mastkuren mit Insulin und über insulare Fettsucht, Wien. klin. Wchnschr. **38**:757 (July 2) 1925.

13. Short, J. J.: Increasing Weight with Insulin: Preliminary Report, J. Lab. & Clin. Med. **14**:330 (Jan.) 1929.

14. Metz, R. D.: Insulin in Malnutrition, J. A. M. A. **96**:1456 (May 2) 1931.

15. Nichol, E. E.: Use of Insulin in Fattening Lean Individuals, J. Florida M. A. **16**:29 (July) 1929.

16. Barker, L. F.: On the Management of Patients Exhibiting Profound Undernutrition, Including the Use of Insulin as an Agent for the Promotion of Appetite and Gain of Weight, M. J. & Rec. **137**:1 (Jan. 4) 1933.

17. Blotner, H.: Observations on the Effect of Insulin in Thin Persons, J. A. M. A. **100**:88 (Jan. 14) 1933.

Next to its value in the treatment of diabetes, insulin appears to have given the most satisfactory results in the treatment of constitutional asthenia; however, since Pitfield's original work insulin has been administered by some enthusiast for almost every known medical and surgical condition, and the results reported have been almost uniformly favorable as far as gain in weight is concerned.

#### EFFECT OF INSULIN IN THE PSYCHOSES

In contrast to the theoretical, experimental, medical and surgical fields, the literature dealing with the use of insulin in cases of the psychoses is comparatively scant and the results reported are much less conclusive.

Cowie and his associates<sup>18</sup> in 1923 found that insulin changed the prolonged dextrose utilization curve which they had observed in patients with depressive psychoses to a normal curve. Targowla and Lamache<sup>19</sup> in 1926 used insulin in the treatment of two undernourished psychotic patients. One had depression with tuberculosis. Improvement in the mental state, increased appetite and a slight gain in weight resulted. The second patient had involuntional melancholia and after a brief course of treatment showed apparently favorable results. Misholczy<sup>20</sup> in 1927 reported good results from the use of insulin in the treatment of patients with manic-depressive psychoses and of negativistic schizophrenic patients with emaciation. In some of his cases he considered that insulin actually overcame the mechanism of abulia.

Appel, Farr and Marshall<sup>21</sup> in 1928, working in the Department for Mental and Nervous Diseases of the Pennsylvania Hospital, used insulin in the treatment of thirty-three patients with psychoses who presented intractable malnutrition. They concluded: "Our results indicate that insulin treatment properly controlled is a valuable adjunct in the treatment of certain critical cases of undernutrition in psychotic patients." The appetite increased and there was a marked gain in weight. The skin took on a more healthy color, and definite improvement in the mental status was observed in 20 per cent of the patients.

18. Cowie, D. W.; Parsons, J. P., and Raphael, T.: Insulin and the Mental State of Depression, *J. Michigan M. Soc.* **22**:383, 1923.

19. Targowla, R., and Lamache, A.: L'insuline dans les états d'anorexie, de sitiophobie et de nutrition chez des psychopathes, *Encéphale* **21**:713, 1926.

20. Misholczy, D.: Insulinmastkur bei Nerven- und Geisteskrankheiten, *Psychiat.-neurol. Wchnschr.* **29**:34 (Jan. 8) 1927.

21. Appel, K. E.; Farr, C. B., and Marshall, H. K.: Insulin Therapy in Undernourished Psychotic Patients; Preliminary Report, *J. A. M. A.* **90**:1788 (June 2) 1928.

In 1929 Appel and Farr<sup>22</sup> found a fall in the blood sugar of 29 per cent within ninety minutes after the administration of insulin; in other words, the type of psychosis did not affect the curve. The blood sugar curve obtained by them was much like that plotted by Barker<sup>23</sup> for the mentally normal nondiabetic person who is being given insulin.

In the same year Appel, Farr and Marshall<sup>24</sup> reported results in an additional series of twenty-eight psychotic patients; a few lost weight, while the others gained, some obtaining a weight never previously reached. The gain in weight was relatively permanent; mentally, however, there was no striking change.

From 1928 to 1931 several German workers (Becker,<sup>25</sup> Haack,<sup>26</sup> Jaschke,<sup>27</sup> Slotopolsky<sup>28</sup> and Grundler<sup>29</sup> used insulin in the treatment of patients who were refusing food. In some cases the attempts to stimulate the appetite by creating hunger were successful.

#### TECHNIC

The following routine procedure was strictly adhered to: In order to minimize unavoidable environmental changes the patients were kept at their usual routine. During the course of treatment each patient was given fluids freely and laxatives when needed. The patients were weighed weekly, and detailed bedside records were kept. The blood sugar value was estimated before and after the course of treatment and intermittently during the administration of insulin; urinalyses and blood counts were made, and the hemoglobin content was measured.

Insulin was injected subcutaneously thirty minutes before each meal; the site was varied with each injection. In order to test for sensitivity and to avoid the possibility of shock, the dosage was stepped up carefully during the first four days of treatment, so that the maximum was reached on the fifth day, and it was stepped down correspondingly during the last four days. Each course lasted forty days; in all 1,100 units of insulin was required.

Care was taken that each unit of insulin injected was buffered at meal-time by the ingestion of at least 5 Gm. of carbohydrate in the regular diet. Otherwise, except to see that the patient had all the sugar she desired, no particular attempt

22. Appel, K. E., and Farr, C. B.: The Blood Sugar Reaction to Insulin in Psychoses, *Arch. Neurol. & Psychiat.* **21**:145 (Jan.) 1929.

23. Barker, quoted by Appel, Farr and Marshall.<sup>21</sup>

24. Appel, K. E.; Farr, C. B., and Marshall, H. K.: Insulin in Undernutrition in the Psychoses, *Arch. Neurol. & Psychiat.* **21**:149 (Jan.) 1929.

25. Becker: Injections for Insane Patients Refusing Food, *Psychiat.-neurol. Wchnschr.* **30**:547 (Nov. 24) 1928.

26. Haack, H.: Injections to Create Hunger in Insane Patients Refusing Food, *Psychiat.-neurol. Wchnschr.* **31**:195 (April 20) 1929.

27. Jaschke, O.: Injection of Insulin in Insane Patients Refusing Food, *Psychiat.-neurol. Wchnschr.* **31**:545 (Nov. 2) 1929.

28. Slotopolsky, B.: Insulin Feeding of Psychotic Patients Who Refuse Food, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **136**:367, 1931.

29. Grundler, W.: Insulin Injections for Insane Patients Refusing Food, *Psychiat.-neurol. Wchnschr.* **33**:157 (April 4) 1931.

was made to change or to add to the routine hospital diet until the patient's increasing appetite required an increase in the caloric intake. Two patients (cases 4 and 14) were fed by tube throughout and received 4,000 calories per day.

Because of the mental condition of the patients, the possibility of the occurrence of hypoglycemia or insulin shock was an ever-present worry. Nurses were cautioned to watch closely for rapid pulse, dilatation of the pupils, restlessness, tremors, staggering gait, perspiration with thirst and weakness, laughing, crying or complaint of hunger. Little need was found for the orange juice and sugar and none for the dextrose solution which were kept ready for intravenous injection in an emergency.

#### MATERIAL

Five women with the negativistic form of Kraepelin's catatonia, whose conditions were descriptively as nearly identical as possible, were selected for a course of insulin therapy. While other approaches were not neglected, the chief interest was directed toward possible variations in the clinical picture of the stupor. Nine controls were used: two psychoneurotic women; two women with catatonic dementia praecox without stupor; two women with paranoid dementia praecox, one of whom had passed into a mute catatonic-like state; one woman with a depressive psychosis of manic-depressive type; one woman with involutional melancholia, and one woman employee who was much underweight, asthenic and became fatigued easily.

#### RESULTS IN STUPOROUS CATATONIA

Like Blotner,<sup>30</sup> I found during insulin therapy a stationary blood sugar curve and an increase in the cell count and the hemoglobin content proportionate to the improvement in physical health. The menstrual function was not influenced. Three patients (including patient 4, who showed great gain in weight and mental improvement) had not menstruated since admission to the hospital; one menstruated (patient 1) scantily once before and once after treatment, and one (patient 2) continued to menstruate profusely throughout the illness.

The appetite seemed to be increased, but change in weight, with one exception (patient 4), was small. As was to be expected, however, the patients who had been in the hospital for the shortest time showed the greatest physical improvement.

Patient 4, who had been recently admitted to the hospital, was fed by tube and received 4,000 calories per day until she began to eat on the fortieth day. The appetite of the other four patients improved steadily until they were taking from 2,000 to 3,500 calories per day. Patient 2, who spontaneously began to work on the second day of the course, lost 1 pound (0.5 Kg.), while the other three patients gained from 2 to 8 pounds (0.9 to 3.6 Kg.). The three last mentioned, who were from 14 to 19 pounds (6.4 to 8.6 Kg.) underweight at the time of treatment, were from 10 to 21 pounds (4.5 to 9.5 Kg.) underweight six months after treatment. Patient 4, who was 5 pounds (2.3 Kg.) overweight at the beginning of treatment, was 49 pounds (22.2 Kg.) overweight six months later, while patient 2, in spite of her industry and the loss of 8 pounds, was still 13 pounds (5.9 Kg.) overweight. The mental improvement in these two patients who were overweight conforms with the fact frequently observed in catatonia, that the patient puts on excessive flesh as he recovers mental health. In every patient, however, the improvement in physical appearance was greater than that warranted by the gain in weight.

30. Blotner, H.: Insulin in Malnutrition, *J. A. M. A.* **100**:1235 (April 22) 1933.

The characteristic catatonic mottling of the extremities disappeared during treatment in all five patients, but promptly recurred in the two (patients 1 and 5) who showed no mental improvement, and more slowly in patient 3, in whom there was slight improvement. Gastro-intestinal function and sleep were improved in every patient. There was no instance of insulin shock.

The physical gain was slight, and the effect of insulin on the catatonic stupor per se, in which I have been particularly interested, was nil. The two patients with long-standing cases of endogenous origin (patients 1 and 5) did not show a particle of change symptomatically. The other three patients, in whom there was acute onset with adequate emotional causes as precipitating factors, were improving, as would be expected.

Tables 1 to 4 show the physical and mental changes in concise form.

TABLE 1.—*Weight Before and After Insulin Therapy of Five Patients with Dementia Praecox and Catatonic Stupor*

Patient	Age, Years	Weight, Pounds	
		Before Treatment	Six Months After Treatment
1.....	31	97	102
2.....	28	140	132
3.....	27	102	106
4.....	25	110	154
5.....	33	110	108

TABLE 2.—*The Weight Before and After Insulin Therapy of Controls Who Were Nonstuporous*

Patient	Age, Years	Weight, Pounds	
		Before Treatment	Six Months After Treatment
6.....	32	92	92
7.....	28	82	70
8.....	55	83	83
9.....	47	101	110
10.....	23	93	97
11.....	36	110	107
12.....	48	104	96
13.....	39	103	98
14.....	30	80	78

#### RESULTS IN THE CONTROLS

The observations on the so-called controls were of much more interest than those on the five patients with catatonia. The lack of greater physical change was more difficult to understand, for all nine belonged to the group with constitutional asthenia, and who, most investigators agree, respond particularly well physically.

The employee (patient 6), a tense but well adjusted, happy woman aged 32, gained 6 pounds (2.7 Kg.) during the course of treatment, lost much of her tenseness and reported a definite decrease in fatigability. Much to her surprise and mine, there was a relapse as soon as insulin was stopped, and within the subsequent three weeks, on the same diet, there was a loss of 8 pounds, which was all she had gained plus 2 additional pounds. Becoming alarmed, she took two weeks' vacation; forced feeding, tonics and fourteen hours of sleep daily enabled her to regain the 2 pounds, which merely effected a return to her weight before treatment.

The patients with paranoid dementia praecox were perhaps the most interesting of the series. The first (patient 7) gained 3 pounds (1.3 Kg.) during treatment; then in two months she lost 15 pounds (6.8 Kg.), and six months later she weighed 12 pounds (5.4 Kg.) less than at the commencement of treatment. Patient 14, with paranoid dementia praecox with a catatonia-like state, was fed by tube throughout with 4,000 calories per day, and gained 10 pounds; this gain was more apparent than real, however, for the patient was greatly dehydrated at the beginning of treatment. Her weight within two months was 100 pounds (45.4 Kg.), but six months later it had dropped to 78 pounds (35.4 Kg.). The patient was still mute,

TABLE 3.—*Mental Changes in Patients with Dementia Praecox and Catatonic Stupor*

Patient	Mental Changes	
	During Treatment	After Treatment
1.....	None	None
2.....	Lost rigidity, began to work	Enthusiastic worker; talked a little
3.....	Less resistive; began to talk	Improved slowly; tended to excitability
4.....	Improvement parallel to gain in weight	Nearly ready for parole
5.....	None	None

TABLE 4.—*Mental Changes in the Controls Who Were Nonstuporous*

Case	Diagnosis	Mental Changes	
		During Treatment	After Treatment
6*	Asthenia	Feeling of well-being	Slumped
7	Paranoid dementia praecox	Complaining	Demanded more attention
8	Involuntional melancholia	Very resistive	More delusional
9	Mixed psychoneurosis	Very irritable	Feeling of well-being
10	Dementia praecox and catatonia	None	More productive
11	Mixed psychoneurosis	Regressed	Returned to former level
12	Depressive psychosis of manic-depressive type	None	None
13	Dementia praecox and catatonia	Began to work	Continued to work, but was increasingly paranoid
14	Paranoid dementia praecox	None	None

\* This control was an employee who was much underweight.

and resistive, and required feeding by tube. It is of interest that during moderately severe insulin shock the catatonia entirely disappeared and she talked freely and moved about easily for an hour, just as some catatonic patients do under the influence of sodium amytal. Patient 8, with involuntional melancholia, also had slight insulin shock; her weight remained stationary and her mental condition regressed. There was no change in patient 12 with manic-depressive depression. Neither of the psychoneurotic patients (patients 9 and 11) showed an appreciable permanent change. Patient 11 showed great mental regression during treatment, and patient 9 gained 9 pounds (4.1 Kg.), which was retained. One catatonic patient without stupor (patient 10) gained a little weight; the other (patient 13) lost weight. Patient 10 became more productive mentally, while patient 13 a few days after the commencement of treatment propped herself up in bed and asked to do the mending for the persons in the ward. She worked industriously from that time, but her mental productions became increasingly bizarre and paranoid.



## SUMMARY

Insulin was administered to five patients with catatonic stupor, approximately 30 units per day being given for forty days without variation of the routine diet or the environment so far as this was possible. Two patients showed no change in the clinical condition, either mentally or physically. The remaining three, whose psychoses were all of relatively acute onset, of short duration and associated with definite emotional precipitating agents, showed the improvement that is commonly observed in persons with this type of condition with insulin treatment or without it. It is not possible, therefore, to estimate the influence of insulin therapy on the patients reported on in this communication.

Essentially the same results were observed in a group of nine patients who exhibited various clinical syndromes other than catatonic stupor. The one interesting observation, which may offer a starting point for further investigation, was the disappearance of the catatonic mottling of the extremities during treatment.

## THE PERCEPTUAL BASIS OF SOMATIC DELUSIONS IN A CASE OF SCHIZOPHRENIA

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Complaints of particular disturbances, referred by patients to the tactile, kinesthetic and cenesthetic spheres, are common in cases of schizophrenia and represent an important component of the schizophrenic symptomatology. As regards the nature of such phenomena, various opinions are current. Many writers regard them as delusions ("somatic delusions"), that is, ideational productions; others classify them with hallucinations, and some regard them as peripherally aroused sensory experiences with or without delusional elaboration. Probably all these types actually occur in schizophrenic patients; only a careful analysis can determine the true nature of the phenomena in question. A case is presented in which the mechanism of delusion formation seems to have been elucidated.

A white man, aged 30, who was admitted to the Worcester State Hospital about six years ago, is said to have been a slow, dreamy and sensitive boy. He finished high school and spent a year in a trade school but became discouraged by poor results in school and went to work as a farm-hand. During the year or two preceding admission, he gradually became depressed and more seclusive. He would retire immediately after supper and asked that no one come around where he was. Once, when his father questioned his behavior, the patient, with tears in his eyes, replied that he was "all shot to pieces" and that his "head had been going" for the past few months. Two months before admission he began to talk about some danger threatening the family; they were going to be killed by four Irishmen. During this period he would not eat with the rest of the family but would wait until they had finished and then go to the table and eat alone. For two weeks he did not leave the house. He would stand in the doorway, seeming not to know where he wanted to go. During this period he did not speak unless spoken to and for a few days preceding admission did not talk at all. In the hospital his disorder was diagnosed as schizophrenia of the mixed catatonic-hebephrenic type.

The family history, the personal past history and the detailed psychopathologic picture have no immediate relevance for the phenomena to be discussed in this paper and hence are omitted. One characteristic of the psychosis, however, which seemed to be a basic factor in the symptomatology, namely, severe disturbances of self-awareness, should be mentioned because they have, in my opinion, an intimate relation to the phenomena to be described.

Perhaps the most fundamental structure in adult mental life is the differentiation of the stream of experience into subject and object.

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From the Research Service of the Worcester State Hospital

Certain psychic data are experienced as constituting one's self, the empirical ego, while other experiences are ascribed to an external world. The most fundamental part of the self-awareness is the perception of one's own body, but many other factors enter to build up the complicated structure of the self.<sup>1</sup> The differentiation into ego and nonego is presumably not made by the new-born infant but becomes possible only as a result of psychologic development. In certain pathologic states and in dreams this structure may be profoundly disturbed. The line of separation between one's self and the self of other persons as well as between the self and the external world can be displaced, or the line of distinction may even more or less disappear.

My patient gives many evidences of schizophrenic depersonalization. He complains that parts of his body do not belong to him, that they do not feel "lifelike." "One could hang them on a hook—it would be just the same." He has lost "the stuff" that belonged to him. "They take out [his] stomach and everything." He cannot "raise his vitality." He is "just like a stick of wood." The whole array of symptoms observed in states of schizophrenic depersonalization are present in this patient. "They" have divided him into many persons, into many "images" or "figures:" "One sits here on the chair, the other stands outside in the corridor, one-third runs around somewhere; I'm here and I'm there, too. The question is, who is who?" He often does not recognize his actions as his own but feels himself as a passive tool in the hands of his persecutors, as exemplified in the following statement: "I have no chance to think; they use my head. They pull my hand. They make my feet move. They speak with my mouth. I don't speak, the words just fly out of my mouth, it doesn't take any effort." The distinction between himself and the outside world is blurred and produces the so-called "cosmic identification." "They upset me . . . they upset the whole earth." (Examiner: "Whom do they upset, the earth or you?") "I'm the earth and the earth is me; that is the way it looks like to me."

These few examples will suffice to show how deeply affected is the structure of self-awareness in this patient. These profound disturbances of self-awareness seem to account in large measure, at least, for the genesis of his somatic complaints.

The patient often complains of a group of troublesome phenomena which consist mainly of an impression as if the ground were swinging rhythmically up and down under his feet and as if at the same time it were becoming soft or the floor were covered with "dirt," with "some soft dusty stuff."

These last complaints suggested that the symptoms have some relation to a particular tactile-kinesthetic illusion that can be elicited in the normal subject. The illusion in question was first described by Ponzo.<sup>2</sup> If, under certain conditions, one presses a cutaneous surface against a hard object, one has the impression that the object swells and retracts or moves back and forth perpendicularly to the cutaneous surface. If one presses a pencil between the thumb and the index

1. See, for example, the chapter on "Consciousness of Self" in James, W.: *The Principles of Psychology*, New York, H. Holt & Co., 1890.

2. Ponzo, M.: *Dell'influenza esercitata da complessi associativi abituali su alcune rappresentazioni di movimento*, Riv. phil. neo-scol. 5:5 (Aug) 1913.

finger, under certain conditions, one experiences an apparent rhythmic pulsatory movement of the pencil in the form of an alternate expansion and contraction of that part of the pencil which is in contact with the fingers. The apparent expansion is synchronous with the arteriolar systolic period and the contraction with the diastolic period. These apparent movements are due to the fact that the tactile organs of the skin are squeezed against the hard surface and released with every pulsation. It is, however, not a purely tactile phenomenon but partially of muscular origin because, besides the tactile stimulation, the state of tension in the soft tissues under the skin also fluctuates with every pulsation. The projection of movement is accompanied, as I have previously reported,<sup>3</sup> by another illusion: During the apparent movement of the object one has the impression of touching no longer a hard surface but a soft pulsating mass.

This experiment is usually successful only in the case of experienced subjects. Ponzo has devised, therefore, another experiment, which is based on the same psychologic principle and which elicits the phenomenon with greater ease and clarity.

The subject sits before a table and lets the elbows rest on it, with the forearms perpendicular to the surface of the table and with the palms turned medially. He then holds a rigid object—for example, a small wooden board, about 10 inches (25 cm.) long—in such a manner that the ends of the board are in touch with the proximal third of the volar surfaces of the two forearms. If he alternately clenches and opens the hand, the diameter of the flexor muscles of the forearm increases and decreases. But instead of perceiving this, the subject has the impression that the board alternately increases and decreases in length.

The common feature in both phenomena is that a movement of the body is exteriorized—projected into an object. Ponzo explained the objectivation of movements in the following way: The movements occurring in the external world are, from a biologic point of view, much more important for oneself than the movements of the body. Attention is therefore directed toward the movements occurring in the external world, while one usually has only a vague perception of the movements of the body, especially when they are automatic or slight. Ponzo referred also to the “influence of habitual associations through which we tend to consider each cutaneous sensation as due to a stimulus which acts from the external world upon our organism because the greatest number of cutaneous stimulations arise, in fact, in the external world.”

The factors invoked by Ponzo are certainly important in producing these phenomena. In order to understand better the symptoms of my

3. Angyal, A.: Einige Beobachtungen über raumhafte Tastphänomene, *Arch. f. d. ges. Psychol.* **71**:351, 1929.

patient, however, it is desirable to formulate the problem in a somewhat different way and to emphasize also some other factors.

If an external object is pressed against the skin or if the skin is pressed by an endogenous force against an external object, the local conditions (as Ponzo has already stated) are in both cases the same, namely, increasing pressure on the tactile organs of the skin and on the underlying soft tissues. The sensations at the locus of increasing pressure do not give one any cue to judge whether the pressure was moving toward the body, or vice versa. One ascribes the movement to the object or to one's own body, respectively, on the basis of secondary criteria. The most decisive factor, in my opinion, is the accompanying state, whether of activity or of passivity. If the movement is not voluntary and other criteria are absent, there is a tendency to perceive the movement under the described conditions as belonging to the object. The movement in the experiment of the board held between the forearms is also not voluntary in the psychologic sense of the word; the clenching of the hand is intended, but not the increase of the diameter of the flexors of the forearm and not the increase of the pressure on the object held between the forearms. In such a case under an uncritical attitude one feels the clenching of the hand as made by oneself and the increase of pressure on the forearms as something which came about without one's will.

In the case of rhythmic change of pressure in consequence of systolic-diastolic changes, the conditions are somewhat different. For the localization of the movement in such cases the determining factor is how well the sensation of changing pressure on that part of the body which is in touch with the external object is connected with the rest of the total picture of the body. As far as my observations go, one can ascribe the movement in such cases to the body, perhaps because there is a faint perception of the arterial pulsation not only in the part which is in touch with the object but also in other parts of the body; hence, one perceives it as a part of a general pulsation. A change in pressure in consequence of arterial pulsation has a wider and different spread than a change in pressure caused by external influences. At any rate, the localization in such cases depends on the clearness of the total picture which one has from the bodily self and on the degree of integration of the sensations of changing pressure at a particular locality into this total picture of the body. By clearness of the total picture of the bodily self is meant not merely the clearness of somatic sensations but primarily the specific ego-reference, the integration into the ego. Without such an organization one would have no bodily self but only a complex of particular sensations.

Both phenomena have a common basis: A movement originating in the body becomes detached from the rest of the self-awareness and

projected into the external world. In one of my examples the movement was due to unnoticed activity of the muscle on the forearm, and in the other, to changes of blood pressure. The factors involved in the phenomenon of exteriorization of movement may be different in different cases, but the basis is always the same: the detachment of a group of sensations from the rest of self-awareness or a loss of ego-reference.

If such a view is correct, one may expect that in states in which self-awareness is disturbed one will find a great number of illusions of this type. One of the psychic states in which one finds a marked disorganization of the consciousness of self, as emphasized elsewhere,<sup>4</sup> is the hypnagogic and the dream state. In that paper attention was called also to the fact that sometimes just before the dream proper begins there is a short "foreperiod" when self-awareness is completely annulled and psychic life is reduced to a minimum. In such a state every sensation of the body is objectivated and projected outward. In this foreperiod the described type of illusions has been found, as a matter of personal experience, to be easily elicited.

In my first personal experience of such illusions I was just on the point of falling asleep. My hand chanced to be pressed against a wall. It seemed as if the wall were swinging back and forth. The illusion was caused by the transmission of the respiratory movements to the arm and hand, which movements were projected into the wall. This and similar observations have often been repeated in states of sleepiness.

In the formal experimental situation something similar occurs. I mentioned that the exteriorization of movement occurs only under certain conditions. The most important of them is a certain inner attitude of the subject during the experiment. In many subjects the illusion fails to arise just because of the lack of this attitude. This favorable attitude for the production of these illusions is similar to that when one wants to fall asleep, which is mainly an attempt to lose the consciousness of the self, to forget oneself.

It would be expected that in persons showing such profound disturbances of self-awareness as my patient, illusions based on objectivation of somatic sensations would be more likely to occur than in other persons.

The patient often complains that "the floor is not steady enough," that it is "wavy," and that some soft, dusty material is coming up from the floor. "Something is coming through the floor," he once said. "It goes back and forth—back and forth." Another time he explained: "You can feel with the feet, something

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4. Angyal, A.: *Der Schlummerzustand*, *Ztschr. f. Psychol.* **103**:65, 1927.



is going up and down in the floor." He complains also about the softness of the ground, usually in a paranoid-delusional manner. "They cause you troubles all the time. They soften the floor."

These complaints suggest strongly that they are of the nature of the previously described tactile-kinesthetic illusion due to the oscillations of blood pressure on the plantar region which is in touch with the ground. This assumption has been tested in different ways. When the patient was asked to take his feet from the floor the phenomenon immediately disappeared, which showed that it is a tactile and not, for example, a visual experience to which the patient refers. Once when he complained again about this apparently troublesome experience he was asked a few indifferent questions in order to distract his attention; then he was requested to place his palm against the wall and to report what he felt. After a few seconds he said: "Something is coming out of the wall. It goes back and forth—back and forth." Then he continued to interpret his experience in a delusional manner: "The horse comes out of the wall. Some animal flesh." On another occasion he was requested to put his hand on the table. He said: "You can feel it. Some stuff is coming through the table." ("What does the table feel like?") "It feels rather soft," was the reply. The experiments were often repeated and always with similar results. They showed further that the phenomenon is not restricted to the plantar region but can be produced at any part of the body. The predilection of the plantar region for this phenomenon is probably due to the fact that the patient usually stands all day in some corner of the ward, which must increase the sensation of pulsation in his feet. The illusion appears sometimes spontaneously also on other parts of the body. For example, he sometimes complains that "they" move his teeth in and out in his jaw. This belief is doubtless due to the pulsatory oscillations of pressure between the alveolar cavity and the tooth. Under certain conditions such pulsations are clearly perceptible in every person.

The following circumstances speak for the identity of these symptoms with the tactile-kinesthetic illusions due to perceptions of pulsatory changes of pressure in the body: (1) the rhythmic pulsatory character of the movement; (2) a contemporaneous sensation of softness of the object into which the movement is projected which, as has been pointed out, is characteristic of such illusions, and (3) the important condition for the appearance of such illusions, namely, reduced or disturbed self-awareness, is in high degree present in this patient.

Besides the apparent movement of objects having a rhythmic character and which are due to vascular pulsations in the body, one can observe in this patient objectivation of other movements also, e. g., of voluntary movements which are not recognized by the patient as his own actions. He often feels himself passively moved about by foreign forces: "They pull my hand; they move my feet; I don't speak, it doesn't take any effort, the words just fly out of my mouth," etc.

When some part of his body is in touch with an object and the pressure on the object is increased or diminished by action of the skeletal muscles, but when the action is inadvertent or at least not recognized as voluntary, the movement is projected into the object, and this later seems to the patient to move toward or away from his body. Thus, when he starts to move he often makes a number of apparently aimless movements (for example, he makes suddenly a step to one side or backward in walking) which at first seem to be a kind of mannerism but

which are experienced by the patient as not his own movements but something done to him. He calls such movements "extra motions" because they intercalate as a surplus into his consciously intended movements. These "extra motions" usually fade away at their beginning and remain only as fragments of movement. For example, he starts to stand up from the chair but does not rise, and the movement is stopped in its initial stage. However, this rudimentary movement is sufficient to change the pressure of the gluteus muscles on the chair and is perceived as a movement of the chair. This illusion often appeared spontaneously during interviews with the patient and hence could be studied at length. On such occasions he suddenly moves to the edge of the chair or stands up and begins to touch the place where he was just sitting, as if to explore. He says that he suddenly "felt some stuff coming up from the chair" or that he felt that "the chair was going up into the air."<sup>5</sup>

These illusions are even more marked when the patient stands on his feet. The displacement of weight of the body from one foot to the other and by this a decrease of pressure in the plantar region of one foot and an increase in the other form an abundant source for illusory movements localized in the ground. These phenomena are especially evident when the patient starts to walk. "As long as I stand on a spot," he said once, "it is all right, but when I start to go, the whole thing [the spot] moves."

When he starts to make a step he often stops it at the very beginning because his attention is attracted by the strange impressions he has. The changes of pressure on the plantar region he perceives as upward and downward movements of the floor. One of his most frequent complaints is that "they hill up the floor" or "they make holes in it." Once he remarked: "The floor seems clear and smooth, but when I come they make hills." Or: "They make holes in the ground to drop me in." It is interesting to watch how he suddenly stops walking and steps back when he feels himself falling or stepping into such a "hole," and then how cautiously he explores the ground, pushing forward one foot to see "whether it is safe enough to step on it."

One is convinced that these complaints are in fact based on the illusions to which I refer if one observes the movements of the patient and compares them with his coinciding subjective impressions; one sees how well the objective conditions check with the contemporaneous complaints.

Another source for projection is his respiratory movement. This occurs when the patient is leaning against the wall or against the back of the chair. In such cases the movement is projected into the wall or the back of the chair. This illusion is, however, not very frequent.

Besides the projection of movements of the body into external objects there is another kinesthetic illusion observed in normal subjects which seems to be responsible for a great number of "paresthesias" in this patient (Ponzo<sup>6</sup> and Ponzo and Angyal<sup>7</sup>). One of Ponzo's experiments,

5. It is noteworthy that even such a common symptom as compulsion to touch things (which seems to be present in a characteristic form in this patient) can sometimes reveal itself, after a close analysis, as something quite different. However, I admit that the coexistence of compulsive tendencies is not ruled out completely.

6. Ponzo, M.: Phénomènes d'annulation perceptive avec des "stimulus" subliminaires, *Kwartalnik Psychol.* **1**:3, 1930.

7. Ponzo, M., and Angyal, A.: Zur Systematik der Gewichtsempfindungen, *Arch. f. d. ges. Psychol.* **88**:630, 1933.

which demonstrates well the phenomenon in question, is the following: The subject standing with eyes closed holds a receptacle in his hand with the arms stretched directly up. The receptacle is filled with water (for example, 300 Gm.). The bottom of the receptacle is connected with a tube through which the water can be drained noiselessly by opening a stop-cock. In such conditions the subject usually does not notice that the receptacle has gradually lost weight, though the loss of weight far exceeds the threshold of sensibility. The first change of which he becomes aware—and this usually happens when the greater part of the water is drained off—is a peculiar sensation as if the receptacle had suddenly lost its complete weight, or better, as if it had now a kind of negative weight and would tend to fly out of his hand.

In the same situation if one directs attention to the sensations in the arm and not to the receptacle, one observes marked deformations of the "postural model of the body." One feels as if the arm would considerably elongate itself.<sup>8</sup> The deformation extends itself on the whole postural model of the body and one feels as if one were becoming taller.

If one places the receptacle on a muscle group and then drains off the water a similar phenomenon arises. The phenomenon can be demonstrated convincingly, if one has the subject lie down and places the receptacle on the eyeball. When the weight diminishes, a clear impression arises as if the eye were protruding out of the face several inches. Other subjects describe the phenomenon as if a light substance were emanating from the ocular cavity.

My patient often complains about peculiar sensations as though he were losing something of his body. "I lose some stuff that belonged to me. It goes right out through my bottom. They yank out the stuff of my bottom." At first I thought that these ideas were related in some way to the process of defecation, but after repeated questioning this possibility was excluded because the patient stated positively that the "stuff" irradiates from the whole gluteal surface. Once he explained to me the sensation in the following way: "If I sit awhile on the bench and then I stand up, a stuff goes out from my bottom which is ten times lighter than air."

These and similar statements made me suspect that his complaints are based on the peculiar kinesthetic after-sensation which is found in the experiment of relieving pressure on the eyeballs. I was several times a witness when this phenomenon had just occurred, and my observations convinced me even more that this is a kinesthetic after-sensation caused by relieving the pressure on the muscoli glutei, because the phenomenon appeared always just when the patient arose from the chair or a few seconds later. The impression that some material is going out from his body must have a realistic character for him. For example, the patient started to rise from a chair, but when only half-way he straightened up and suddenly grabbed behind himself as if to catch something. When I questioned

8. This phenomenon is related to, but not identical with, the phenomenon of Kohnstamm.

his behavior, he said: "The stuff was going apart. My stomach was going apart." Sometimes he expresses a feeling of losing something by saying that "they open up" on him. Once, for example, after he stood up from the chair and made a few steps he suddenly turned his head as if looking for something behind him. When his behavior was questioned, he answered. "I am losing something. They open up my tail end." A similar phenomenon arises probably also when in walking the patient lifts up his feet from the ground and so relieves the pressure on the plantar surface. He complains often that he loses his "foot-prints;" he leaves something behind himself by walking. In walking he often returns to look on the floor for the "stuff" which he lost. One is not astonished to find in this patient who, so to say, at every step is subjected to these illusions, severe disturbances of psychomotor activity and especially disturbances of gait. The psychomotor disturbances, however, will not be further discussed in this paper because in addition to the illusions described other factors enter into their production.

In this connection, however, the relation of these phenomena to another symptom presented by the patient may be mentioned. He shows a negativistic attitude toward eating, and for a time was fed with a spoon. There are evidences that the negativistic attitude toward eating in this patient is, at least in part, due to the same order of phenomena as those just described. He states: "If you eat you can't hold the food long enough in your stomach. It goes right through." Or: "No use to eat if I'm going to lose it. They pull it out of my bottom." After discussing these symptoms on several occasions with the patient I was able to ascertain that he was referring to the sensation of a light substance emanating from the gluteal surface. These complaints, however, are not based exclusively on the peculiar kinesthetic after-sensation but are in part due to a not uncommon disturbance of self-awareness, namely, to the impression that the inside of the body is empty. This feeling of emptiness of the body combined with the sensation of an emanating substance from the gluteal surface arouses in him the impression that he is losing the food and his inside ("I lose my stomach," etc.).

It seems, therefore, that some symptoms common in schizophrenia, such as mannerisms of gait, compulsion to touch things and negativism toward eating, seem in this patient to be closely related to particular tactile kinesthetic phenomena. Other factors may, of course, produce such phenomena. Only a careful analysis of a large number of cases can give reliable information as to how often these kinesthetic phenomena are responsible. Moreover, the verbal reports of schizophrenic patients can be accepted only with caution.

Some symptoms described in this case suggest disturbances of the vestibular system. Also many other symptoms are present which are characteristic of vestibular disturbances:<sup>9</sup> sensation of falling through space, floating up into the air, being "spinned around," standing on the head, etc. Also, "the people from the outside come into the building flying through the air." He often has micropic hallucinations and speaks about sudden darkening of the visual field, etc. Vestibular disturbances

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9. P. Schilder, in a recent article (*J. Ment. & Nerv. Dis.* **78**:1 [July]; 137 [Aug.] 1933) discussed in detail the rôle of vestibular disturbances in neuroses and psychoses.

and disturbances of the perception of one's own body are closely related to each other. My explanation of the patient's symptoms on a tactile-kinesthetic basis does not exclude the participation of the vestibular system.

#### SUMMARY

An analysis of the somatic delusions of a schizophrenic patient is presented. The perceptual basis of such delusions proved to consist of certain tactile and kinesthetic phenomena which under certain conditions also appear in normal persons. One of these phenomena consists in the projection of a movement produced by the organism itself (by arterial pulsation, respiratory movements or activity of the skeletal muscles) into an external object which is in contact with the moving part of the body. As another source of somatic delusions were found certain peculiar kinesthetic after-sensations which arise when, without the knowledge of the subject, pressure is removed from a muscle group (for example, by diminishing gradually the weight of an object resting on a certain muscle group). The kinesthetic after-sensation which arises under such conditions consists in an impression that a substance is emanating from the particular region of the body from which the pressure was removed. The frequent occurrence of such phenomena in this patient seems to be due to severe disturbances of self-awareness.

## SOME SIGNS OF ORGANIC DISORDER IN SCHIZOPHRENIA

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LANE, KAN.

A recent study<sup>1</sup> of the organic functions in patients with schizophrenia made at the Worcester State Hospital in Massachusetts showed that persons with this psychosis present a deviation from the normal maintenance of a "steady state" in many bodily functions. The similar data obtained in the study reported here were gathered largely before the article mentioned was published. A comparison of the results of the two studies is interesting.

This study was undertaken at the Northern State Hospital. Data were obtained on fifty patients with schizophrenia in whose cases the diagnosis was unquestioned by the staff and who did not at the time of admission present definite evidence of a known organic disease other than schizophrenia. One exception was a man who proved to have mild hyperthyroidism. Another presented some evidence of an old, well compensated, inactive mitral lesion. Thirty-five of the patients were men, and fifteen were women. Fourteen had schizophrenia of the paranoid type, thirteen, of the excited catatonic type, and eight, of the depressed catatonic type. In the remainder the disease was of some other type. Similar data were obtained on twenty manic and hypomanic patients. All the patients were admitted to the hospital after Jan. 1, 1933. Twenty-five items recorded in the course of the routine laboratory and physical examinations at the time of admission were: age, weight, height, number of red blood cells, total number of white cells, percentage of lymphocytes, neutrophils, monocytes and other blood cells, percentage of nonsegmented cells, blood urea, blood sugar, metabolic rate, albuminuria, indicanuria, total acidity of the urine, systolic blood pressure, pulse rate, temperature, dermatographia, cyanosis, curved nails, clammy extremities, excessive salivation and body odor.

The laboratory examinations were made by the laboratory staff of the hospital. Specimens were obtained in the early morning after fasting. The value for the metabolic rate on admission was used in the study since the rate in few of the patients was retested. These metabolic readings should not be considered as basal because they were initial readings, but one might hope to approach the basal rate by subtracting

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From the Northern State Hospital, Sedro-Woolley, Wash.

1. Hoskins, R. G., and Sleeper, F. H.: The Organic Functions in Schizophrenia, *Arch. Neurol. & Psychiat.* **30**:123 (July) 1933.



12 from the initial readings, as was suggested recently by Hoskins.<sup>2</sup> Metabolism tests could not be made on some of the more excited manic and catatonic patients because of lack of cooperation. For that reason the studies on the metabolic rate in excited patients leave much to be desired.

The data on the physical examination were obtained from the records prepared by staff physicians as a part of the routine. Some of the physicians probably failed to record as many items as could have been noted at admission, but sufficient of them, such as the presence of

TABLE 1.—Mean Values, Range of Variability and Average Deviation in Various Organic Functions in Patients with Schizophrenia and with Mania

	Schizophrenic Patients (50)			Manic Patients (20)		
	Mean	Range	Average Deviation	Mean	Range	Average Deviation
Age, years.....	27	17 to 48	4.12	35	16 to 56	8.75
Weight, pounds.....	127	89 to 185	12.93	151	98 to 186	16.83
Red blood cells, thousands	4,500	3,300 to 5,900*	216.3	4,300	3,640 to 5,750*	348.0
White blood cells.....	7,750	4,400 to 14,700*	1,796.0	7,000	4,500 to 15,400*	2,950.0
Lymphocytes.....	37	12 to 62*	8.56	36	22 to 50	8.0
Neutrophils.....	58	36 to 86*	9.25	60	42 to 89*	10.15
Nonsgmented cells, percentage	5	2 to 15	2.11	6	2 to 18	3.37
Blood urea, mg. per 100 cc.	18	10 to 32	4.52	21.15	9.5 to 45*	7.63
Blood sugar, mg. per 100 cc.	100	61 to 136*	12.58	103	80 to 140	11.2
Basal metabolic rate	-2	-48 to +36*	8.45	Few cooperative enough for test		
Systolic blood pressure	116	90 to 140	6.64	128	104 to 150	10.05
Pulse rate.....	72	44 to 100*	10.12	80	64 to 110*	11.5
Pulse pressure.....	40	18 to 60*	6.31	50	21 to 60*	8.26

\* This range ran both above and below the limits of normal.

dermographia or curved finger-nails, have been recorded to be of interest. I recorded the blood pressure and pulse rate under conditions which approached basal, but without the extreme care which was taken at the Worcester State Hospital. The tests were usually made early in the day, and the patient was induced to lie quietly for a few minutes before the reading.

In table 1 the mean value, the range of variability and the average deviation for each of several functions are recorded. Since the number of manic patients studied was only 40 per cent of the number of schizophrenic patients, it is to be expected that the mean for this group is

2. Hoskins, R. G.: Oxygen Consumption in Schizophrenia, Arch. Neurol. & Psychiat. 28:1346 (Dec.) 1932.

not as representative nor is the range as wide as for the schizophrenic group.

The difference in body weight between the patients in the two groups was partially due to the difference in age. However, the schizophrenic patients were on the average 10 per cent underweight, as predicted by the nutritional index, while the manic patients were 1 per cent underweight in spite of the fact that many were acutely excited and some were exhausted on admission. There was a definite shift to the left in the count of nonsegmented cells in 10 per cent of the patients in each group, in none of whom any infection was noted. It was not definitely determined whether the shift was regenerative or degenerative, a distinction which Schilling has emphasized.<sup>3</sup> In the few blood smears in schizophrenic patients in which I have observed a shift there was such a predominance of stab cells as to indicate that the shift is not regenerative.

By a consideration of the blood cells in their relation to each other, it was determined that 38 per cent of the schizophrenic patients showed the following combination: normal total white cell count, lymphocytosis, neutropenia and normal count of nonsegmented cells. A normal white cell count and differential count were found in 28 per cent of the schizophrenic patients. In no case did the blood cell count suggest a septic process, although leukocytosis occurred in 12 per cent of the patients and neutrophilia in 12 per cent, with the two conditions overlapping in 4 per cent. None of the 10 per cent of the schizophrenic patients in whom there was a shift to the left showed leukocytosis or neutrophilia. On the other hand, a septic process was suggested in 15 per cent of the manic patients by the following combination: leukocytosis, neutrophilia and a shift to the left. However, no infection was found. There was nothing remarkable about the number of monocytes, transitional cells or eosinophils. Occasionally a Rieder cell or a Türk irritation cell was found in the blood of a schizophrenic patient.

The increased amount of blood urea on admission in both series of patients seemed to be characteristic of certain acute conditions. The blood urea was increased above 17 mg. per hundred cubic centimeters in 52 per cent of the schizophrenic patients and in 50 per cent of those with mania. In only 6 per cent of the schizophrenic patients were both urea and creatinine increased to abnormal levels. Although albuminuria occurred frequently, only two schizophrenic and one manic patient showed it in conjunction with an increased content of urea and creatinine in the blood. All these unusual findings disappeared promptly with general treatment and routine in the ward; none of the patients showed signs of chronic nephritis. The results of the urea clearance test would have been of interest had it been made.

3. Schilling, Victor: *The Blood Picture*, translated by R. B. H. Gradwohl, St. Louis, C. V. Mosby Company, 1929, p. 266.

A comparison of the observations on the various types of schizophrenia was attempted, but only the three types mentioned in table 2 were represented in a sufficient number of cases to make the observations significant, and even these cases were too few for the results to carry much weight. It seemed undesirable to consider the excited catatonic patients in the same category with depressed patients. In spite of the paucity of cases of each type, table 2 indicates that the physiologic functions in excited schizophrenic patients are in contrast with those in schizophrenic patients in a quiescent state, but that there is a striking similarity to those in excited manic patients. There may also be something characteristic about these functions in patients with the paranoid

TABLE 2.—*Comparison of Some of the Organic Functions in Persons with Various Types of Schizophrenia*

	Paranoid		Excited Catatonic		Depressed Catatonic	
	Mean	Average Deviation	Mean	Average Deviation	Mean	Average Deviation
Age, years.....	33	5.23	24	5.58	22	4
Weight, pounds.....	143	14.25	114	14.44	125	15
Red blood cells.....	4,800,000	616,000	4,200,000	444,444	4,400,000	398,000
White blood cells.....	6,900	1,308	8,250	1,433	7,300	1,425
Lymphocytes, percentage.....	43	5.50	32	8.46	29	10.23
Neutrophils, percentage.....	56	6.46	60	10.16	70	8.66
Nonsegmented cells, percentage...	4	1.69	5	1.7	5.5	3.0
Blood urea, mg. per 100 cc.....	17	3.82	16	4.41	15	3.51
Blood sugar, mg. per 100 cc.....	95	10.54	102	10.27	95	13.0
Basal metabolic rate.....	-5	6.9	Data incomplete		-6	4.0
Systolic pressure.....	122	10.0	115	6.21	115	6.11
Pulse rate.....	68	8.61	80	12.84	73	6.5
Pulse pressure.....	40	6.0	40	5.27	38	8.25

type of schizophrenia. The tendency to wide deviation from the norm is definitely present in each type.

Schizophrenic and manic patients often present certain signs which cannot well be expressed numerically like the preceding data. These signs appear in relatively few subjects at the time of admission and usually disappear readily under routine management in the ward either with or without treatment of any kind. There seems to be a tendency for excited catatonic patients to show acidosis and albuminuria, while paranoid patients show a relatively greater incidence of curved finger-nails. The distribution of these signs is shown in table 3.

The frequency of the occurrence of more than one of these signs in the same person is shown in table 4.

The occurrence of curved finger-nails in so many schizophrenic patients aroused the suspicion that a chronic infection may cause this phenomenon. But chronic infections, such as tuberculosis and bronchiectasis, usually progress to genuine clubbing of the fingers. There

was no clubbing in any patient of this series, and I have seen only one schizophrenic patient who had clubbed fingers at the time of admission. On the other hand, it is said that intestinal toxemia, which can scarcely be called an exogenous infection, causes curved finger-nails. It is also conceivable that poor circulation in the extremities, caused by autonomic imbalance, may produce curving of the finger-nails. Eleven of the schizophrenic patients, or 22 per cent, showed curved finger-nails associated with circulatory signs such as cyanotic or cold, clammy extremities.

TABLE 3.—*Distribution of Certain Signs of Chronic Indisposition*

Sign	Schizophrenic Patients	Manic Patients
Dermographia.....	7	0
Cyanosis of the extremities.....	17	3
Curved finger-nails.....	21	2
Clammy, cold palms.....	11	1
Excessive salivation.....	4	0
Offensive body odor.....	7	1
Indicanuria.....	6	4
Acetonuria.....	6	3
Acidity of urine over 60.....	6	6
Albuminuria.....	22	11

TABLE 4.—*Occurrence of More than One Chronic Sign in an Individual Patient*

Number of Toxic Signs per Patient	Condition			
	Depressed Catatonia	Excited Catatonia	Paranoia	Mania
2.....	0	1	1	4
3.....	0	5	3	3
4.....	1	0	1	0
5.....	3	1	0	0
6.....	1	0	0	0

Records of temperature were taken twice daily for three days following admission. The results were:

Range of Temperature *	Patients with Schizophrenia, Percentage	Patients in a Manic State, Percentage
Normal (98 to 99 F.).....	46	30
Subnormal (below 98 F.).....	28	10
Above normal (above 99 F.).....	6	45
Picket fence (below 98 F. and above 99 F.).....	20	15

Since pyrexia is ordinarily a sign of infection it was interesting to note its appearance in conjunction with other signs of infection. One schizophrenic patient with pyrexia had leukocytosis but no other sign of infection. Another had a neutrophil count of 74 per cent. The others showed nothing to suggest an infection. On the other hand, four of nine manic patients who had pyrexia had other definite signs of infection such as leukocytosis, a high neutrophil count and a shift to the left (in two patients), even though no infection was found. Ten per

cent of the schizophrenic patients who showed a definite shift to the left in the count of nonsegmented cells did not have fever. A shift to the left with definite lymphocytosis in a patient with schizophrenia may indicate tuberculosis with good defenses. However, it may indicate nothing more than the definite inability of a schizophrenic person to maintain the steady physiologic state. As evidence that schizophrenic persons react normally in the presence of infection, one of my patients had an attack of appendicitis three months after admission. The laboratory evidences of infection were: leukocytosis, marked neutrophilia, a marked shift to the left, tachycardia and fever. In most schizophrenic patients in whom there is no definitely recognizable infection the total

TABLE 5.—*Comparison of Some Organic Functions in a Man with Schizophrenia of the Depressed Catatonic Type, 22 Years of Age, on Admission and After a Lapse of Seven Months*

	Admission	Seven Months Later
Red blood cells, thousands.....	5,000	4,500
White blood cells.....	10,500	5,700
Hemoglobin, percentage.....	92	85
Lymphocytes, percentage.....	24	36
Neutrophils, percentage.....	75	59
Monocytes, percentage.....	1	4
Nonsegmented cells, percentage.....	4	8
Blood urea, mg.....	16.8	12.3
Albumin.....	Faint trace	0
Total acidity of urine, degrees.....	89	30
Blood pressure.....	102/84	130/100
Pulse rate.....	64	73
Temperature, F.....	98 to 98.8	97.6 to 98

white cell count, the temperature, the pulse rate and the neutrophil and nonsegmented cell count seem to vary without relation to each other.

A comparison of certain observations on schizophrenic patients with observations on patients with Addison's disease will be reserved for consideration in another paper which will deal with the use of an extract of the adrenal cortex in the treatment of patients with mental disease.

Extreme variability of the organic functions in schizophrenia has been noted. In the few patients on whom tests were repeated after a lapse of time, without the intervention of effective treatment or significant mental change, it was observed that this tendency to variation or the lack of homeostasis was present in the same subject at various times in the course of the mental disorder. This has been pointed out by Hoskins and Sleeper.<sup>1</sup> Table 5 shows such a trend in a depressed catatonic patient aged 22 years in whom there was no significant mental or general physical change during seven months.

## COMMENT

The evidence here presented supports the contention of Bowman and Raymond<sup>4</sup> that the physical symptoms in schizophrenia are similar to those in the affective psychoses. The most characteristic feature in the data for both the manic and the schizophrenic patients in this series was the tendency to variability of organic functions from time to time and from patient to patient. This inconsistency suggests that such organic features as are found in these psychoses may not be due to any one underlying organic process. Schizophrenia does not conform to the picture of even the most chronic infectious process, although infection is suggested at times. Even though 50 per cent of schizophrenic patients who died at the Northern State Hospital had pulmonary tuberculosis, it cannot be maintained that this infection was primary. Perhaps the majority of patients suffering from schizophrenia are also predisposed by constitution to tuberculosis, which may explain the frequent coincidental occurrence. Endocrine dysfunction seems to be the most consistent explanation of the observations of various authors. Even here, however, there is no single gland which can be consistently blamed. It has already been suggested that a few schizophrenic subjects may suffer from hypo-adrenia—but only a few. Hypothyroidism may be suggested in the majority of cases, but a minority of the patients distinctly have hyperthyroidism. Perhaps the pituitary gland is at fault since it acts on most of the other glands. There is no need to postulate that any one gland is constitutionally weak in schizophrenia or that it may have been injured through some organic disease process. The entire neuro-endocrine system is influenced by the play of various emotions. It would seem that the best explanation of this variety of organic disorder is neither of a primary somatic nor of a psychogenic cause but of an intimate interaction of both, so that the total organism reacts in a thoroughly disorganized and incoherent manner intellectually, emotionally and physiologically.

It is of interest to note that catatonia has been produced experimentally in animals by the use of drugs.<sup>5</sup> The fact that one of the drugs was epinephrine, which is also produced in the body in association with certain emotional states, is an eloquent argument in favor of the view that one need not and cannot effectively separate somatic from psychogenic factors. The distinctions of philosophic dualism have become so ingrained in one's reactions that one has become conditioned to mirages or to things which do not exist.

4. Bowman, Karl M., and Raymond, Alice F.: Physical Findings in Schizophrenia, *Am. J. Psychiat.* **8**:901 (March) 1929.

5. Henry, George W.: Catatonia in Animals, *Am. J. Psychiat.* **11**:757 (Jan.) 1932.



In the series of schizophrenic patients in this study the condition was relatively more acute than in those studied by Hoskins and Sleeper since these data were taken from examinations on admission. In spite of this the similarity in results is striking. The mean values for most of the functions observed in this study show the same relation to normal as did those of the patients at Worcester State Hospital, although the means vary as to actual level. Notable exceptions are found in the total white cell count, which in my series seemed to be below rather than above normal. Other functions which varied in level were: urea content, systolic blood pressure and pulse rate—the first because of the relative acuteness of the condition and the last two because of failure to reach basal values. In my series there were more toxic and acidotic features owing to the more acute condition. The more frequent presence of indicanuria on admission suggested the presence of intestinal toxemia, which Hoskins and Sleeper said was not present in their schizophrenic patients. However, the formation of indican is a complex matter which involves the function of both the liver and the intestines and perhaps of other organs. Moreover, indicanuria is only one of many signs of intestinal dysfunction, about many of which little is known; its absence cannot be cited as convincing evidence that toxemia does not exist. Neither can all the toxic signs in schizophrenia be attributed to intestinal disturbances since some of the signs could be caused by autonomic imbalance. Perhaps an unfavorable thalamic stimulation is the etiologic factor.

There seems to be a tendency in patients with each diagnostic type of schizophrenia to present physiologic functions of a nature roughly differentiated from the rest, at least as shown by central tendencies within the group. Since diagnostic criteria are largely based on emotional behavior, it may be inferred that each emotional state may have its physiologic accompaniments. This may be inferred for normal as well as for abnormal emotional states. This does not mean that the etiology of schizophrenia is purely psychogenic. It is wiser to suspect constitutional factors, both mental and physical, which are even more remotely predisposing and on which the psychosis may be built. Other organic factors which may appear are usually secondary. Each forms a link in the vicious chain of events leading to the irreparable loss of integration in personality and physiologic organization. So one may look on such data as those presented here as representing the somatic accompaniments of faulty psychobiologic reactions.<sup>6</sup>

6. Katzenelbogen, S., and Buchman, E. F.: Studies of Blood Sugar Curves in Mental Disorders, *Am. J. Psychiat.* **13**:321 (Sept.) 1933.

## CONCLUSIONS

Patients with acute schizophrenia show greater inability to maintain the steady physiologic state than do patients with quiescent and chronic schizophrenia. Manic patients also maintain homeostasis poorly. There appears to be a correlation between the physiologic functions and various types of emotional behavior, on the basis of which diagnosis of the various so-called functional psychoses is made.

## SUMMARY

Fifty schizophrenic patients and twenty manic-depressive patients with a manic type of psychosis were studied with reference to twenty-six physiologic functions recorded soon after admission to a state hospital.

The most characteristic feature was the sporadic and inconsistent appearance of many unexplained variations from the norm in all functions, in such a manner that the central tendencies were near the normal in most cases. This was true of both the manic and the schizophrenic patients. The patients with various types of schizophrenia tended to have physiologic variations characteristic of the type to which the disease belonged.

## A METHOD FOR INVESTIGATING FANTASIES

### THE THEMATIC APPERCEPTION TEST

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Psychoanalysis attempts to represent the underlying dynamics of personality as an interaction of forces. Each force is a need which impels the individual person to pursue a certain course of activity—a course of activity which usually involves a certain kind of object. An inhibited or repressed force with its associated impressions of objects may manifest itself in the guise of a fantasy which the subject can report on, or its presence may be inferred by the analyst on the basis of other phenomena. In the latter case the analyst is apt to speak of it as a repressed unconscious fantasy. Since the exposition of such hidden fantasies is one of the fundamental aims of analysis and since, at best, the customary technic for accomplishing it calls for a long period of watchful waiting, it seems that it would be helpful if a more expeditious method could be devised. For, if the analyst were cognizant at the very start of the fundamental fantasy constructions of his patient he should be in a better position to apperceive and to interpret the dynamic relations of what, in the beginning of an analysis, is ordinarily fragmentary and obscure. He might also, at a later stage, have a better idea of what might be considered irrelevant as well as what important latent trends had yet to be disclosed.

The method which is to be described is based on the well recognized fact that when some one attempts to interpret a complex social situation he is apt to tell as much about himself as he is about the phenomena on which attention is focused. At such times the person is off his guard, since he believes that he is merely explaining objective occurrences. To one with "double hearing," however, he is exposing certain inner forces and arrangements—wishes, fears and traces of past experience. Another fact which was relied on in devising the present method is that a great deal of written fiction is the conscious or unconscious expression of the author's experiences or fantasies. The process involved is that of projection—something well known to analysts. It is utilized in the Rorschach test.

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## PROCEDURE

The procedure which suggested itself was this: to present subjects with a series of pictures, each of which depicts a different dramatic event, with the instructions to interpret the action in each picture and give an imaginary reconstruction of the preceding events and the final outcome. It was anticipated that in the performance of this task a subject would necessarily be forced to project some of his own fantasies into the material and so reveal some of his more pressing underlying needs.

Since for purposes of comparison it is desirable to make such a procedure as uniform as possible, that is, to present every subject with similar stimuli and similar instructions for response, the attempt was made to find a standard set of pictures. Each picture should suggest some critical situation and be effective in evoking a fantasy relating to it. The set should also be comprehensive. Ideally, there should be a picture which would act as a trellis to support the growth and unfolding of every root fantasy. It was considered, and the idea was later confirmed by experience, that there should be at least one person in each picture with whom the subject could easily identify himself. Such an object may be termed an evoker, that is, one who evokes empathy in another. Thus, there should be a separate set of pictures for males and females, and also for children, young adults and elderly persons. Since in the present experiments the subjects were all young men between the ages of 20 and 30, most of the pictures to be described included at least one figure of that sex and age. After a preliminary selection from several hundred pictures and an elimination of those which on repeated trials proved unproductive, we found a set of twenty which gave good results. This test was one of many to which fifty subjects were exposed. It formed a part of a comprehensive study of personality in which about twenty experimenters participated.

The subject was seated in a comfortable chair with his back to the experimenter, and the following directions were read to him:

"This is a test of creative imagination. I am going to show you a picture, and I want you to make up a plot or story for which it might be used as an illustration. What is the relation of the individuals in the picture? What has happened to them? What are their present thoughts and feelings? What will be the outcome? I want you to do your very best. As this is a test of literary imagination you may make your story as long and as detailed as you wish."

The subject was then handed picture 1, and the experimenter wrote down everything that he said. If, in giving his story, the subject omitted the antecedent circumstances or the outcome, he was reminded of it by such remarks as, "What led up to this situation?" "How will it end?" etc. When the subject finished his story he was handed picture 2 and asked to proceed as before. There were twenty pictures in the series, but as the test was stopped after an hour most of the subjects did not have time to make up stories for more than two thirds of them.

The test was given once to forty subjects as a group test, the stories being written. The time saved by this method was considerable, but the results were less satisfactory.

After a few days had elapsed each subject was interviewed. This time the experimenter explained that he was studying the imaginative process in the construction of literary plots and that he wished to know if what professional writers had told about their creative experiences was true for every one. The subject was then asked if he would cooperate by trying to remember whether his story had come from something which he had seen or read; whether it had come out of the experience of friends or relatives, or whether it had come out of his own private experience. The subject was then reminded of the plot of each story in turn and encouraged to speak freely and openly.

## RESULTS

An examination of the stories concocted by our subjects in conjunction with material obtained from introspections, autobiographies, hours of free association, interviews, etc., reveals the fact that there were four chief sources from which the plots and the items of the plots were drawn: (1) books and moving pictures, (2) actual events in which a friend or a member of the family participated, (3) experiences (subjective or objective) in the subject's own life and (4) the subject's conscious and unconscious fantasies.

Although the material from the first two of these four sources may seem at first blush to be of little importance, it was discovered that even here much of significance was revealed. This, it seems, may be explained by referring to the tendency exhibited by most subjects to enjoy observing most and to remember best the external events which resemble their underlying fantasies. Thus, when a subject gives a vivid account of an occurrence one may profitably consider whether or not the theme of the event is a clue to his latent personality.

That every subject almost immediately projects his own circumstances, experiences or preoccupations into the evoker was only too obvious. For instance, in one experiment six of the eleven college men who took the test said that the youth in picture 4 was a student, whereas none of the twelve noncollege men who acted as subjects described him as such. One subject, whose father had been a ship's carpenter, wanted to go to sea himself, to travel and see the world. This was his dominant fantasy. Three of the scenes in his stories were laid on board a ship and two were in the Orient. In regard to picture 17, which illustrates a middle-aged man talking to a younger man, the subject said: "The older man is educated and has traveled a lot. He convinces the other to travel, to take a job that will take him to different places." In commenting on a picture which illustrates a young man sitting in a chair brooding rather disconsolately, this subject said: "This is a business man who runs quite a business in town. He is weighing the possibility of a European trip. He has been arguing with his wife on the subject. She got angry because he would not go and finally took up her hat and left. He is thinking it over. He changes his opinion, goes out and buys tickets." In interpreting another picture, illustrating two laborers engaged in conversation, the same subject said: "These two fellows are a pair of adventurers. They always manage to meet in out of the way places. They are now in India. They have heard of a new revolution in South America, and they are planning how they can get there. . . . In the end they work their way in a freighter."

Many other examples of this sort of thing could be cited. No subject failed to exemplify it. Some of them, in fact, gave stories which were frank and unabashed autobiographies, one example of which will be sufficient.

When presented with picture 5, depicting a young lad gazing pensively at a violin which is resting on a table before him, our subject said: "A very sensitive boy—sensitive lips—who is musical by nature. His mother wants him to be a violinist, but his father, who is in business, is averse to it. The father came home one night and heard him squeaking—'squeaking' to him but beautiful to the mother—and told him to stop. He is a highly irritable father with a bad temper, and he

partially destroys the violin. The boy is rudely shocked. He is over his grief now, but is studying the violin with tenderness and sorrow. This upset makes him all the more fervently musical. It gives him new sorrow, making him more mature. It takes away the light spirit of a child and makes him a better artist. His mother buys him a new violin in spite of the father. He continues his playing and so goes on to the life of an artist. By this experience he will have nothing in common with other children of his age. He is more sensitive and will find his greatest happiness in solitude. He becomes a genius, appears at concerts and is acclaimed by critics because he is so precocious. Then his popularity wanes. He deviates to musical expression through the medium of language—literature. He becomes a poet. At 14 or 15 he has had none of the contacts of ordinary youth. He is called a sissy and is quite unhappy. But he glories in the happiness of the consciousness of his own superiority. Others of his age he thinks are silly. School is a limitation. He feels its thorns. His father is interested in his marks rather than in the development of his mind. His mother wants him to be what she couldn't be, but she doesn't influence his intellectual development. She is a pillar of strength to fall back upon, but she doesn't feel deeply. The boy looks on her as inferior but necessary. He goes into philosophy and the arts. If he is not careful he will become sexually abnormal. At nineteen he has written great poetry with great imagination and imagery. He puts deep philosophic thoughts into great language. . . ."

In his introspections this subject admitted: "All of this story is autobiographical." He said further: "My father isn't like that, but he could be. Only by keeping my mouth shut [the subject did not speak until he was 3 years old] is it possible to keep the atmosphere one of indifference. The conflict of the business man and the poet [the subject himself has written poetry and intends to dedicate his life to this calling] is so intense that it could flame out between us as great hostility. There is a lot in it about sorrow. Well, I'll tell you, though you will probably think it foolish. You see I feel that I really want to be like Byron. I want to be highly sensitive as he was. You know the girls in high school ridiculed me when I read them my poetry. I want to expose myself to their scorn and ridicule. I want to be sensitive and expose myself in order to suffer, because it is only through the greatest suffering that we can know anything of life and be strong. . . ."

In his autobiography the subject said: "I have no close attachment to the family and [as a corollary to this condition] no favorite parent. Probably I do favor my mother, however, because I see more of her but the attachment is inconsequential. . . . I was timid and easily beaten in fist fights. I suffered from the barbaric joys of young boys. . . . My favorite story and hero was Robinson Crusoe, lonely and self-sufficient. . . . Writing is my chief aim of the immediate and distant future. I also aim to develop more mature sex relationships. I do not care to try to remodel the world; it is much more intriguing to fathom the one I have found. If I could remodel it, I would like to be the greatest writer—equivalent to prophet—and receive the acclaim of an intelligent populace. Above all, I would like to have the world more alive to and aware of its own beauty."

Although some of this material is suggestive of certain underlying infantile experiences and fantasies, it is not to demonstrate such trends that this case is cited. It is our intention merely to indicate how much important biographic data may sometimes be obtained from a single story and the introspections which follow it. This kind of information.



however, can often be obtained by direct questioning, and the present test would be quite unnecessary if it were only this that one wished to discover. What we have to show is that subjects project their deepest fantasies into such dramatic pictures and thereby reveal directional tensions of which they are quite unconscious. Though some of their stories are elaborations of conscious fantasies, others are not recognized by the subjects as having any personal reference. It is these—in which the personal reference is suggested by other data—that have been ascribed to unconscious fantasies. Of course, the stories as given are conscious fantasies. Like dreams, they must be interpreted if one is to arrive at the unconscious trends which determine them. Before presenting typical case histories to support this assumption, however, it will be necessary to outline the conceptual scheme which we have adopted for the classification of fantasies.

Psychoanalysts have found it convenient to name some of the more common fantasies—the oedipus fantasy, king-slave fantasy, foster-parent fantasy, etc. This naming represents the beginning of a classification—the initial step in the construction of any science—and the practice should be continued until all important fantasies have been so recognized. If this is to be done in a systematic fashion every fantasy must be analyzed into the factors which compose it, so that the groupings may be made in terms of similar fundamental elements.

Our own reflections have led us to the conclusion that every fantasy may be analyzed into a series of events, each event, in turn, being an occurrence which is usually analyzable into: (1) a driving force (or fusion of forces in the subject), (2) an object (or group of objects) toward which or away from which the force is directed, and (3) the outcome of their interaction expressed in terms of subjective feeling—satisfaction or dissatisfaction. This mode of analysis is applicable not only to a fantasy but to an actual event as well. Sometimes it is preferable to speak first of the object, i. e., the environmental press or stimulus situation, and second of the subjective trend, i. e., the response. Stated in this way, our mode of representation resembles the familiar S-R formula of the behaviorists, except that with us the stimulus is more than a single sensation or perception. It is a temporal *Gestalt* of stimuli which bear the same dynamic meaning—the press. And with us the response is ordinarily represented not as a particular muscular movement or reflex but as a need or general course of action, the tendency of which is to produce a certain effect.

To incorporate fantasies into a scientific system of psychology, then, we propose to classify them according to the single events which compose them, every event, as we have pointed out, being classified according to its essential structure. To refer to the dynamic structure or plot of a fantasied event—or, for that matter, of an actual event—we

have found it convenient to use the term *thema* (th.). A simple *thema* we shall define as the abstract formula for a single event. It consists of a particular press-need combination. The term *complex thema* may be used to describe a commonly encountered temporal association of simple *themas*, some of which may be dominant and some subsidiary.

In some events only the press is known or the press is of primary importance (something happens or an object does something and the subject merely experiences it or adapts to it), whereas in other events nothing is known of the press or the press is merely the usual environment and it is the subject's action which is significant. In the former case the press alone will constitute the *thema*, and in the latter case, the need alone. For instance, "p punishment" will describe an event in which the subject is punished by an object, and "n punishment" or just "punishment" will describe an event in which the subject punishes an object. Strictly speaking, a *thema* is the structure of a momentary event, but the term may also be used to describe a long continued press followed by a long continued response, provided the intervening events are more or less irrelevant. For instance, "p family discord" may be used to describe the fact that a child is frequently exposed to quarrels between his father and his mother, and "revenge" may be used to describe a subject's long enduring resentment and a series of retaliative actions.

This brief exposition of the concept of *thema* (th.) was necessary, it seemed, in view of the fact that we have analyzed our material in this way and have proposed a name for every significant *thema* which could be clearly identified. The names, of course, should be regarded merely as suggestions, for they may prove to be inadequately descriptive when more fantasies of the same kind are examined.

Since the subjects who take this test are asked to interpret each picture, that is, to apperceive the plot or dramatic structure exhibited by each picture, we have named it the "thematic apperception test."

#### REVIEW OF CASES

We shall now present the essential details of two typical cases in order to indicate the sort of data which one obtains with this test. It should be noted that though each subject presents a few *themas* which are strikingly similar and others which are dynamically interrelated, the *themas* of one subject, taken as a whole, are very different from those of the other. That is to say, in these cases there are clear individual differences.

CASE 1.—G. was a restless, energetic undergraduate student who was planning to go to the business school. He wanted "to get a position in a big firm" and ultimately to devote part of his time to civic and educational enterprises. "My favorite parent," he wrote in his autobiography, "especially in my early years,

was my father, probably because he rarely punished me. You see my mother was more strict with me." The father was an ardent Republican, but G. could not say enough against this party or, for that matter, against all parties and all government officials—congressmen, politicians and utility magnates. "The only childhood habits I had," he continues, "were thumbsucking (sucking th.) and finickiness about food (oral rejection th.). [For a long time he hated lunch and supper. He had "the life nagged out of him to eat."] . . . At times I was fearful of others, especially of those bigger than myself. Further, I was very sensitive and still am."

It seems that G.'s pride must have been recently wounded by one or more of his friends, for he hinted at a serious quarrel and said: "It pays neither to ridicule nor criticize."

"Personally, I would prefer to use the word 'acquaintance' and not 'friend'," he wrote, "I have looked at this matter objectively and I have come to the conclusion every one is out for what he can get. . . . Hence, I'm really careful to make no really deep friendships and just try to keep all at a certain distance." Later he added: "One's estimate of one's own social world is a most difficult thing. It usually depends on how one has been brought up and how the world treats one. . . . My attitude toward this social world is one of disgust and indifference. . . . The world's estimate [of me] is yet unformed, or should be. Yet, I am young, and till I'm at least 30 I will refrain from passing final judgment on myself and my character." From this one receives the impression that the subject had suffered some rebuff or had been unjustly blamed and as a result had become a Timon. As he said, he was "very sensitive."

G. gave a negative sex history. "My early practices as far as I can remember were none; in fact, I have never even masturbated for no reason that I can discover." When asked how he got on with the girls in his high school, he answered: "Bored. I didn't even look at them while I was there." He was generally scornful of women. He recalled with pleasure the way his father rebuked his mother when he was teaching her to drive. His mother, however, was the stronger of the two and did all the punishing. One of the subject's similes was: "As dangerous as a woman learning to drive." In giving his childhood memories he omitted to mention, but later recalled, an important event which occurred when he was 9—the death from infantile paralysis of a cousin. This cousin was very accomplished for his age; he was adored by his parents and was the constant playmate of the subject. His death was a great shock to the subject. In the clinic the subject, though cooperative and responsive, was indirectly aggressive. He expressed his scorn of the government, university institutions and some of the experimental procedures. When he was left in a room with a self-effacing fellow-undergraduate, however, he was outstandingly agreeable and sympathetic. His behavior under these circumstances seemed to fit in with his avowed intention to devote himself in later life to those who were less fortunate than himself.

*Thematic Apperceptions.*—Picture 4. On the floor against a couch is the huddled form of a boy with his head bowed on his right arm. Beside him on the floor is an object which resembles a revolver.

Subject: "This seems to suggest a normal young boy who has done something wrong. He has been playing with fire or smoking. Father has given him a serious talking to and boy has taken it much to heart. Is thinking it over, crying, thinking of his sins. He will try to be a real good boy after this and obey his parents." (Minor crime [incendiary, smoking] → p punishment [verbal] → reform th.)

"Or, he may have broken some valuable furniture in the house. He is sulking because it was an accident. He did not do it on purpose. He feels an injustice has been done to him." (Minor crime [vandal] → p [unjust] punishment → sulk th.)

"Or, the third possibility is that he has been forsaken by his friends. He is feeling the injustice of a world which has treated him rottenly. It is one of those young troubles we all have. He is thinking, 'I will live by myself now and not associate with them if they have treated me that way.'" (Timon th. = p [social] rejection → [social] rejection th.)

In the last two of these three stories the feeling of "suffered injustice" is encountered. The root of such a feeling is often some infantile experience of deprivation—birth trauma, weaning trauma or rejection trauma. Here the two circumstances occasioning this feeling are censure and rejection. The causes of punishment are playing with fire and breaking valuable furniture. (minor crimes of destruction) and smoking (sin of oral sentence).

Picture 6: The silhouette of a man's figure against a bright window. The rest of the picture is totally dark.

Subject: "This is some person who has lived in poverty. He has never tasted success or happiness. He was an orphan who never had a good start. He tried to build himself up, but failed and is now considering suicide. He has walked to the window. It is a spring day. The flowers and trees are in bloom. He thinks of the wonders of life—the beauty of nature. This brings him back, and he thinks if he should try hard he might be a success. He is young. Every one has disappointments. If he struggles he can overcome the deficiencies in his education. He can go to night school. He forgets the squalor of his surroundings; forgets the people around him, degenerate and degraded. He feels he will get out of that circle. He will keep to himself until he gets out of it. When he makes a fortune he becomes a philanthropist. He becomes very civic-minded, spending money on playgrounds, charities, friends and orphanages. He endows a professor in college, helps a library. He realizes the difficulties he has been through. Though he has had to suffer, others shouldn't. He adopts an orphan, that is, if he didn't get married and a man like that wouldn't. He dies with a smile on his face, having benefited mankind." (Orphan → achievement, failure → suicide; and p deprivation [economic] → traumatic [deprivation] restraining, suprajecction th. → achievement [economic] → charity, adoption of child th.; misogyne th.)

The orphan thema is always suggestive of some infantile experience of suffered deprivation—birth trauma, weaning trauma or rejection trauma. Here it leads (by succor-projection) to the charity thema, that is, pity for a self-like object (narcissistic object choice). The rejection of marriage—"a man like that wouldn't marry"—suggests a retaliative rejection (misogyne th.) or possibly homosexuality.

Picture 11: A young man with his head buried in the lap of a young woman who bends over him with a tender expression.

Subject: "The young fellow is in love. A young lady of a better station has jilted him. He is very unhappy. His mother is consoling him, telling him there are other girls, that he is young, that there is plenty of time. He takes mother's advice, but feels embittered about women. He pays no attention to them after this. He lives as a bachelor. He adopts a girl—or no, a boy. He wants to be a father, and it is easier to be a father to a boy. He gives the child money. His mother is happy over this. He feels motherly toward his adopted son and

they live happily ever after." ([Superior] marriage wish → p[erotic] rejection → dejection, misogyne, adoption of child, mother identification, charity th.)

Here is another variety of the Timon thema—rejection followed by counter-rejection. But in this instance it is specifically the suffered rejection of erotic love followed by woman-hating (misogyne th.). This points to the mother as the original depriver and refuser—birth trauma, weaning trauma or rejection trauma. Again, one finds adoption of a child as the objectified solution of narcissistic self-pity. One might suppose that the subject—after feeling excluded by his mother—determined to become his own loving mother (partial mother identification), and later this endopsychic drama became a fantasy of benevolence to an unloved boy.

Picture 12: A young man helplessly clutched from behind by two hands, one on each of his shoulders. The figure of his antagonist is invisible.

Subject: "This suggests a fellow of less than medium means. He has had to struggle all his life as a clerk in a store, making just enough to keep himself and his wife alive. They have no child. His only happiness lies in marriage, for he sees no chance of rising in his firm. He feels sad and downhearted until he comes home. His wife cheers him. But he finds that she has been unfaithful to him, and he decides to leave. In the picture she is trying to hold him back. She tries to make him listen to reason. She slipped, as we all do, she says, but really loves him. But he goes off with nothing to live for. Now he just works to eat instead of eating to work. He mopes around, very dejected and sour. He doesn't look at life kindly since it gave him this raw deal. She tries to patch things up. But he leaves her again. He often wonders why he did this. It might have been better if he had stayed, but he can't bring himself to do it. The memory of her unfaithfulness always comes up. He dies young, as he has nothing to fight for. He gets sick and lets himself go, and that is the end." (p deprivation [economic] → achievement failure → dejection th.; p. rejection [infidelity] → rejection [erotic, misogyne], dejection, death th.)

In this story erotic rejection is the consequence of suffered infidelity. Perhaps the subject was jealous of his father; perhaps he was shocked when, as a child, he discovered that his mother had sexual intercourse with his father. He left her, partly to heal his wounded pride (retaliative rejection) and partly to revenge himself. (Imposed guilt th., suffering in order to arouse guilt feelings in the object.)

Picture 10: A dimly indicated figure of a man clinging to a rope. He is in the act of climbing up or down.

Subject: "This man is escaping from a dungeon in some foreign country where prisoners are looked on as criminals and there is no mercy. It was a political crime and no mercy was shown. He is out to get even with the world, for the world threw him into jail. Finally he succeeds in getting free after enduring much misery—running through swamps, killing animals with his hands and eating raw meat. He kills a soldier who supports the government and gets his uniform. He reaches a big city and gets a position. He earns money for some new clothes. Then he goes on to the capital and lays plans for revenge. He gets in with the Reds, doing it entirely for revenge. He must get even. The planned revolt is discovered, and he has to flee. This time he has enough money. Then he returns and plans to make his revenge more subtle. He gets a position in the government and gets in contact with the man who was responsible for the original injustice to him. He decides to kidnap this autocrat's child. He makes this man suffer plenty. He kills the child and sends her back. Then he gives himself up in remorse for having taken the life of an innocent child. A priest



comes. He asks forgiveness. He dies with the words on his lips that at least he had made his enemy suffer." (Infraggression [rebel] → [unjust] punishment [prison] → escape, crime [vengeful] biting, murder and kidnaping → atonement th.)

Here is a rather unusual motif—the biting thema, or cannibalism—suggesting that the original form of aggression was directed toward the mother's breast. Perhaps it represents a partial frustration of the child's original reaction to oral frustration—the weaning trauma. Again, one finds the feeling of suffered injustice, but in this case it leads not to separation (misanthrope th.) or aggression through masochism (imposed guilt th.) but to something more primitive—a vengeful counteraggression. After the hero kills an innocent child, however, he feels guilty, suffers remorse and repents.

Picture 7: A short elderly woman stands with her back turned to a tall young man. The latter is looking downward with a perplexed expression, his hat in his hands.

Subject: "This fellow is a good friend of the old lady and her son. The boys were brought up together, played and went to school together. They were always together. They lived in the same house. Then the son of the old lady is killed in an accident. In this picture he had to break the news to her. There is much grief on both parts. He realizes that his friend was her only support, so he feels it is his duty to adopt her as his mother. They run a boarding-house together. He tries to substitute himself as her dead son. Then he wants to get married. But if he does she will object. He doesn't feel that he will be doing right to his friend. It would be an injustice to his friend's memory. The girl, not knowing the facts, is angry at the idea of being thrown over. They have a fight and end it. He is quite pleased now that he has made the decision. If the girl is that kind of a girl he did well not to marry her, for the marriage would never have been a success. The old woman dies. This time he finds a nicer girl. She feels for him in his sorrow over his friend. She feels he did wonderfully to have done as he did. He marries her. The story ends happily." (p death [friend], p bereavement, bearer of sad tidings → self as substitute offspring, better parent th.; love → [erotic] renunciation from loyalty → quarrel → rejection [erotic]; love th.)

Here again the subject brings in the adoption of child thema, but with this picture the subject can maintain his active attitude toward adoption only by having the hero adopt the mother. This suggests the possibility that at one time the subject wanted to be adopted (better parent th.). There is also the possibility that the intense loyalty which binds the hero to his dead friend is based on a previous homosexual attachment.

In his introspections after studying picture 3, the subject referred to his young cousin—a boy who had died. He said: "Aunt and Uncle had a boy just my age. He was a very handsome and gifted child. He died of infantile paralysis when he was 9. Although Aunt and Uncle had two girls, they were heart-broken. They thought of adopting an orphan. They used to take great interest in a boy in an orphanage and in the orphanage itself. I was very much impressed at the time. My parents never talked about it, but I picked up a good deal."

Since the adoption of child thema is an unusual one and since it appears three times in this subject's stories, one must suppose that it plays an important rôle in his unconscious psychic structure. Moreover, since the idea of adoption was presented to him just after the death of his gifted playmate, there is reason to suppose that the adoption of child thema took root at that time. The story evoked by picture 7 suggests that after his cousin's death the idea occurred to



him that he might be adopted by his aunt and uncle. Two factors may have conspired to produce this fantasy—dissatisfaction with his own parents and guilt over his cousin's death. The evidence in favor of the former is rather strong—a deep-seated feeling of suffered injustice. (p. rejection, Timon th., [erotic] rejection th., misogyne th., dejection th.) These trends point to an early oral trauma. One fantasy formation after punishment may have been that of aggression through masochism—"I hope I shall die so that my parents will suffer. They will grieve and feel remorseful because of the way they treated me" (imposed guilt th.). If the subject did concoct this common fantasy, his aunt and uncle grieving over their son's death would have appeared to him in the guise of ideal parents.

The data pointing to guilt experienced by the subject after his cousin's death are fragmentary and inconclusive. We have learned that the cousin was more gifted than the subject, and hence the latter may have been envious of him and may have entertained and repressed aggressive fantasies toward him. When infantile paralysis set in the subject may have felt that his death wishes were responsible. In the subject's apperceptions the only act which was followed by guilt was the murder of an innocent child. In picture 7 the hero "feels it is his duty" to adopt the elderly woman as his mother. What except guilty feelings could make him feel that this was his duty? By replacing the lost son and being a model boy he could achieve salvation.

Picture 17: A young man sitting opposite to an older man. The latter has his hand out as though emphasizing some point in an argument.

Subject: "Prodigal son out of college. Father is determined that he must work for a living. He tells him pointblank that he won't give him a job. He must start from the bottom. The boy feels disgusted and angry, but he takes a job and after two months begins to take an interest. He is promoted. In two years he has made quite a success. His father is beaming all over. The boy is living by himself. He meets a working-class girl. She is not what he is used to—not a "deb"—but he falls in love with her. Father hears of this and decides that things have gone far enough. He wants him to come back, but the boy tears up his father's letter and marries the girl. He is now head of the department. Has children. His wife is intelligent—she has studied, has taste for art, music and literature. She is a really good companion. The father meets the girl by accident, is taken with her and finally takes them back. They come to live with the father. But the son refuses to enter his father's business. He demands that the father sell his business and endow a university. Father does this. The son now becomes president of his company." (p deprivation [economic] → achievement → [inferior] marriage → p dominance [coercive opposition] → autonomy → achievement → p pardon → imposition of atonement, charity th.)

The principal point of interest in this story is the charity thema functioning as an atonement for injury done to others. This supports the assumption that the charity thema as well as the adoption of child thema represents a way to salvation.

The following relevant root experiences and reaction formations are suggested by this subject's seven stories:

(a) Oral deprivation and later deprivation of parental love. The subject said that he was very sensitive. He was babied as a child. In the clinic he made many movements of his lips and many hand-to-mouth movements while he was working. He said that as a boy he knew that women were different from men because they had "mammary glands." He thought then that children grew from a seed planted by God in a mother's "heart." He had a number of memories

relating to food, and he used a number of expressions with food associations, such as "he couldn't earn a crust of bread." He liked girls who were "sweet and understanding," and he said that a "sympathetic understanding was the basis of any profitable procedure." These fragmentary items, added to the evidence supplied by the thematic apperceptions, and the autobiography, made the assumption of an oral deprivation trauma rather plausible.

(b) Counter-rejection of love, oral aggression. The subject's mother did most of the punishing, and it is probable that aggression was primarily directed against her. The subject had a scornful attitude toward women. "O, women, how fickle!" he said on one occasion. He spoke of "biting someone's head off" and of "blasting things to bits." He was at all times verbally very aggressive, as has been pointed out. The hypothesis proposed is that his aggression was initially a reaction to oral frustration and later a retaliation for unjust censure by his father. We also suggest the presence of envy aggression against his more talented cousin.

(c) Death of cousin, guilt and the wish to be adopted. The arguments to support the significance of these factors were previously presented (discussion of picture 7). The hypothesis proposed was that the wish to be adopted was a fusion of the wish for ideal parents and the wish to atone for his guilt.

(d) Achievement. The subject has high ambitions, and he works with great zest and industry. He wishes to make a lot of money in business. This may be explained as restriving after economic deprivation as a substitute for love and as a way to philanthropy.

(e) Charity, and the adoption of a son. These trends were in the service of his own "orphan feeling," which would be relieved by helping others, and also represented ways of atoning for his former aggression. He wants to be of service to the community. He said: "If I had money I would endow scholarships; give it where it would do the greatest good for humanity, for people."

CASE 2.—B. was an undergraduate student concentrating on music. Though habitually diffident and reserved, he was responsive and submissive to those whom he respected. The muscles about his eyes were frequently contracted as though he were photophobic. This gave him an expression of puzzled anxiety. He was neatly dressed, and his social personality was unobtrusive and banal. He came to the clinic complaining of a symptom which had worried and hindered him for two years—the recurrence of stereotyped images which interfered with normal imaginal processes. He was particularly bothered when he tried to read, for the automatic imagery prevented the generation of such associations as the printed words would ordinarily have suggested. The result of this was that imaginative understanding was blocked and memory for meanings greatly diminished. He found, however, that he had a photographic memory—that the image of the printed page was retained, though the sense of it was lost. This enabled him to get high marks in his examinations.

The stereotyped images were mostly of two sorts: scenes of the distant past—buildings, woods, pastures and brooks in and about his native town in the South—and scenes recently observed—Harvard Square, the Boston State House, etc. The images were static and did not contribute to a fantasy. No human or animal figures appeared, and the presentations seemed to be entirely innocuous.

There was nothing in B.'s autobiography or in the information that he volunteered during the preliminary interviews which seemed to bear directly on the symptomatology. He said that he was born and brought up in a small southern town and was the son of strict Methodists. He had no favorite parent, though his disposition resembled his father's, and he was more influenced by him than

by his mother. His father was an impressive figure—a large man with high ethical standards and an explosive temper to reenforce them. There was a baby sister who died two years before Berry's birth, and another sister, three years his junior, with whom as a boy he frequently quarreled. He remembered being punished for scratching his sister and talking back to his mother. In his childhood he was afraid of many things—water, animals and automobile accidents. He had recurrent nightmares of being chased by a bull.

He described himself as timid, sensitive and reticent. He had frequent inferiority feelings. He played with dolls with his sister until he was 9. At school he avoided participation in organized athletics. He said that he had a strong possessive instinct and that he took great pains to keep his belongings neatly in order. He was extremely sensitive to smells.

As a child he thought frequently of death. He recalled seeing the corpse of a man who had been killed by falling off a hayrick. He remembered his grandmother's funeral—his breaking into tears and being pitied. He was intensely afraid that his parents would die. Though his mother nagged him, she also lavished her affection on him—more, in fact, than B. was inclined to reciprocate.

He did not masturbate until he was 18. He has never had sexual intercourse. He slept with his father between the ages of 7 and 15, and his sister slept with his mother, all on the same porch. At 12 years of age a cousin of his told him about the mating of animals and of human beings. He was terribly shocked to think that his parents would do anything so vile. He held the theory of anal intercourse. He told of several experiences of fellatio occurring at about the age of 10, but said that there had been none since.

He was once inclined to music as a career, but now he is thinking of going into business.

*Thematic Apperceptions.*—The subject was given the thematic apperception test twice, once before and once after four months of an orthodox psychoanalysis.

Picture 14: The nude figure of a man clinging to a pole.

Subject: "This man is evidently climbing a mast. He is a sailor who has been discovered in some morbid crime—some homosexual crime. He has been chased out of the cabin. He climbs the mast and is shot down." (Crime [homosexual assault] → p aggression [revengeful murder] th.)

After four months of analysis the subject gave the following somewhat modified story:

"The mast of a boat in the Arctic. The fellow is a sexual pervert who has been on the ship. One night he tries homosexual relations. He is unsuccessful. He runs out and, half insane, climbs the mast. His features are distorted and carnal. He commits suicide by leaping into the sea or onto the deck below." (Crime [homosexual] → suicide th.)

This is a frank homosexual story suggesting fellatio or sodomy. In the first story the hero is killed by an external agent, in the second story by an internal agent, the super-ego. In interpreting picture 10 (a man clinging to a rope) the subject has the hero—a former criminal—lose his grip and fall to the ground. This is the vengeance of fate. Four months later he said that the rope to which the man clung was attached to a winch operated by a man who disliked him. "His enemy contrives to let him fall so it appears to be an accident." Thus a criminal career is ended sometimes by punitive measures from without and sometimes by punitive measures from within. In his introspections the subject said: "I have always hated high places. I have a great dread of them. I can't think of a worse situation than having your enemy at the other end of a winch."

Picture 5: A young boy contemplating a violin which rests on a table in front of him.

Subject: "This is a picture of a boy violinist. He has a thoughtful expression, getting more introspective and philosophic. He thinks about what makes the tone. Recital follows. It is a great triumph for him. Later, he receives an injury to one of his hands or fingers and he is forced to abandon music." (Achievement th.; p injury [mutilation] → achievement failure th.)

This story suggests castration. After four months of analysis during which time the castration material had been worked over the subject was shown the same picture by another experimenter. This time he said:

"A boy violinist in the early stages of violin practice. He has been playing the score before him. Then, from fatigue or curiosity, he stops and attempts to figure out the physical properties of his instrument. There is no outcome. It is just a momentary episode." (Curiosity th.)

Picture 4: On the floor against a couch is the huddled form of a boy with his head bowed on his right arm. Beside him on the floor is an object which resembles a revolver.

Subject: "A contemporary youngster. In a fit of rage he has shot a pet—a horse or a dog. The animal angered him. He killed it. Overcome with grief he rushes into the house and falls into a fit of remorse." (Supraggression [animal murder] → remorse th.)

In his introspection the subject said: "This recalls a youngster who chopped off the head of a kitten. I had a pet pony myself once."

Four months later the subject presented the following modification:

"A boy with a weapon. He has done something and is sorry. His parents gave him a dog and in a fit of anger he injured the dog with a knife. The dog ran off whimpering. The fellow is sorry. It makes an impression on him in later life. (Supraggression [animal mutilation] → remorse th.)

In his introspections the subject said: "I once had a dog. I used to have to beat him. I always felt sorry afterward."

Children often beat animals after a parent has punished them—something which is usually interpreted as an identification with the parent as well as a catharsis of their own aggression against the parent. A certain acceptance of the parent's authority and an identification with him are often involved, the punishment of the animal being an externalized self-punishment. This is suggestive of true sadism—the infliction of pain on weak and defenseless objects (supraggression). p Bestiality should also be considered. After giving the first story the subject was reminded of "a youngster who chopped the head off a kitten," and in the second story he substituted a knife for the revolver. This is again suggestive of castration (p mutilation).

Many of the other stories included unspecified acts of violence, and there were also misdemeanors vaguely described as "getting involved with some girl." In three stories, however, the subject definitely directed the violence against a woman.

Picture 25: A girl standing alone. The expression on her face is obviously one of terror and anxiety.

Subject: "Girl about to be attacked by a demented person. She has gone on a picnic with him. A coming storm increases the carnal instincts of the boy. He attacks the girl." (Sadism th.)

Picture 18: A malicious-looking man grasping the arm of a young girl who appears to be trying to pull away from him. He clutches her throat, and her expression denotes terror.

Subject: "The old fellow is an experimental scientist. The girl is his secretary. He has placed her in that position for his own ends. When the time comes he takes her to attack her or to use her for some evil purpose." (Sadism th.)

In his introspections the subject said: "It recalls a moving picture I once saw of a mad scientist who made statues of human bodies by filling their veins full of ossifying material. This might be the same. The pronounced sexuality of the girl might have a bearing on his intent."

The associations to this picture suggest a necrophilic trend, the sadism being of the anal type.

In one picture the hero's wife has had a difficult labor; in another she is dead or seriously ill, and in a third the hero finds that both his parents have been killed in an accident. Taking these associations in conjunction with the preceding story (picture 18), is there a basis for guessing that the subject fantasies a woman (his mother) being killed by intercourse—*injection of fluid, or accident—as well as by childbirth?*

In two stories the double personality thema appears.

Picture 12: A young man helplessly clutched from behind by two hands, one on each of his shoulders. The figure of his antagonist is invisible.

Subject: "Dr. Jekyll or Mr. Hyde. It is a case of double consciousness. The man is weak by nature. The hands on his shoulders are those of his other consciousness—either higher or lower." (Conflict [id. vs. super-ego] th.)

Picture 19: A gaunt, poorly dressed and disheveled man stands behind and to the right of a well dressed, prosperous-looking man.

Subject: "The man on the right is a banker. The man on the left might be a brother who has gone bad—a degenerate. He has come back to torment the man on the right. Probably it will end by the murder of the brother by the banker. The banker will commit suicide after the murder." (Crime [murder] → suicide th.)

Four months later the subject presented this version:

"This is double consciousness. The man is a banker. The ghost of his sadistic self is in the background. The lower side is not always controllable. It is sure to have a tragic end, or it is a bad brother with a mental defect. The bad man is guilty of violent crimes of a sexual nature." (Sadism th.)

Picture 21: An obscurely outlined figure, which might be male or female, sits musing in the firelight, hands folded.

The subject outlined another conflict: "It is a monk like Abélard," he said, "who has taken the vows and renounced all worldly desires. He becomes repentant over this in the monastery. It is a tragic situation, for there was no lessening of the conflict after making the vows." (Renunciation [erotic] for holiness → conflict [erotic id vs. super-ego] th.)

Perhaps the subject, though preoccupied with sexual fantasies, has inhibited his impulses. Considering this interpretation in conjunction with the double personality thema, one may suppose that his erotic self was repressed and dissociated because of its aberrant—homosexual or sadistically heterosexual—character.

In addition to the pictures, the subject was given a number of inkblots (different from those used by Rorschach) and asked to tell what figures he could make out of them. Three of his associations were pertinent.

Blot 6: "This looks like an illustration from a medical book, like a cut-away dissection of either male or female."

Blot 10: "Appears to be a cross-section of a female pelvis as seen in medical books."



Blot 13: "Man at left seems to be engaged in some sexual act. It might be an embryo or a portion of a miscarriage."

Here again one finds a preoccupation with dead bodies (necrophilia). One finds, moreover, the conjunction of intercourse and miscarriage.

Besides these pictures and these blots, the subject was asked to write a story about a minister who suddenly appeared in his pulpit one Sunday morning wearing a black veil as in "The Minister's Black Veil," by Hawthorne.

The subject had the minister unexpectedly return to his home one evening and find his brother in "compromising circumstances" with a woman whom he had brought there. "The shock of the discovery," he wrote, "and its theological implications affect the vicar to such an extent that he appears the following Sunday in his pulpit with a black veil over his face. The brother meanwhile quietly disappears, and the minister continues the wearing of his strange garb until his death in a few years."

This story is interesting because guilt is located in the eyes—the minister saw something evil and thenceforth blinded himself (repression of voyeurism). Since the subject's symptoms are located in his eyes, it seems that the traumatic experience for him might likewise have been the perceiving of something. This suggests the primal scene. In view of the large amount of sadistic heterosexuality and the suggestion of necrophilia appearing in this subject's appreciations, one might suppose that the sexual act was originally confused with murder.

In brief, then, the data furnished by the pictures suggest: necrophilia, sadism of the anal type, voyeurism, fear of heights, castration anxiety, homosexual perversion (oral or anal) and dissociation resulting from interference of the super-ego. The relations between these trends, however, are not apparent, perhaps because the stories are too short and concise. The subject was not sufficiently encouraged to elaborate them.

*Psychoanalysis.*—At the date of writing, the patient had had five months of analysis. During this period the following trends have manifested themselves in the order named.

(a) *Fellatio Fantasies:* About the time of the first appearance of his symptoms the patient was having fantasies of his first sexual experiences—acts of fellatio at the age of 10 years. Oral sensations accompanied these fantasies. He had felt very guilty about them and attempted, finally with success, to repress them entirely. He was afraid that he was homosexual and wanted to be assured that he was not. Since some of his static images depicted the surroundings in which these fellatio experiences had occurred, it seemed that his symptoms might be regarded as a compromise formation. It was a fellatio fantasy with the sinful part dissociated—a rather typical hysterical mechanism. There was no relief of his symptoms, however, after the analysis of this material.

(b) *Anal Sadistic and Masochistic Trends; Castration Complex:* The patient said that he had slept in a double bed with his father between the ages of 7 and 15. Though he had feared that during sleep he would touch his father's body and had taken special precautions against nocturia, he had had his first emission while lying against his father. He had fantasies of anal copulation with the analyst and similar fantasies in connection with others. He told of his early fear of sharp instruments, dreamed of being beheaded and spoke of his father's ungovernable temper. His father was an enormous man, over 250 pounds (113.4 Kg.) in weight. He was frequently represented by a bull in the subject's dreams. A good deal of anal material and some passive feminine trends were revealed.



(c) Womb Fantasies, Sadistic Trends and Necrophilia: As a child the patient tried to picture himself in his mother's womb and also in his coffin, the two retreats being closely connected. He saw an embryo in a glass jar once, and this started a series of fantasies about pregnancy and birth—illegitimate children and children born blind. He dreamt of opening up a woman and filling her womb with straw. As a boy he had a fantasy that he was pregnant. Shortly afterward he became constipated and lay doubled up on the floor groaning with abdominal pain. In one analytic session he fantasied the head of a child sticking out of the back of a limousine and then cried out that the analyst was pressing him. He experienced a terrific emotional panic, held his head, kicked out with his feet, rolled over on his side. Later, he said that he had lost his breath. This experience suggested a reenactment of the birth trauma. The patient's most exciting fantasy pictured him opening graves and copulating per anum with one corpse after another. Since the subject had slept in his parents' bedroom during his early years, it seemed that this fantasy might be partly explained by supposing that he had witnessed their sexual congress and conceived of it as a murder or necrosexual act. It seemed that birth, death and sexual intercourse were closely related in his mind. He remembers nothing about his sister's birth, which occurred when he was 3 years of age, although he does remember that he was frequently scolded afterward for poking his fingers in her eyes when she lay in her crib. He quarreled with her frequently during his early years. He seemed to hold a deep resentment against his mother. He said that she nagged him and made exorbitant demands for his affection.

Guilt seems to have become connected with his eyes, for his symptoms were located there (conjunctivitis, stereotyped images and photophobia), and even before they appeared he was compulsively taking certain precautions against ocular infection. This followed his reading about gonorrheal conjunctivitis at the age of puberty.

The relations between these unconscious trends have yet to be worked out. We have evidence of fantasied sadistic assaults on women (wombs and corpses) and children (his younger sister); of fantasied anal-erotic relations with men, active and passive (castration anxiety) and of fellatio experiences and wishes. But the genesis of these tendencies and their dynamic connection with his symptoms are problems which still remain to be solved.

Since B. is the only subject who has undergone analysis after the thematic apperception test, we have but little data on which to base any general conclusions. In this single instance, however, the thematic apperceptions adumbrated all the chief trends which five months of analysis were able to reveal.

#### CONCLUSIONS

We have been able to present only a small fraction of the evidence which supports our general conclusion that the thematic apperception test is an effective means of disclosing a subject's regnant preoccupations and some of the unconscious trends which underlie them. The advantages of the test are that it is a simple procedure which may be completed in two hours or in an abbreviated form in half that time, and that it may be performed in a casual and informal fashion. Since the subject is led to believe that it is a test of creative imagination, even when it is given in a clinic, he is unaware of the fact that he is revealing his innermost thoughts. The subject's attention is not on himself, and

so in many instances he indirectly confesses to things which he would not be willing to mention directly. But, more than this, he exposes latent tendencies of the existence of which he is entirely unconscious. For the fantasies by being projected may be inwardly disclaimed and thus avoid complete repression.

Of all the short procedures and tests which we have tried, the results of this one have given us the best understanding of the deeper layers of a personality. It is undoubtedly a useful method for the investigation of fantasy production under various conditions. Whether it is of any value as a preanalytic measure remains to be seen. It may, perhaps, aid a physician in deciding whether a given patient had better be analyzed by a man or by a woman, or it may give some clue to the probable course or length of an analysis.

Our results suggest, however, that the present test will be most helpful when used by trained analysts in cases in which the patient does not need or cannot afford a complete analysis. Undoubtedly many neuroses may be avoided and many spiritual dilemmas solved by proper guidance at the right time. This is particularly true for young persons. In our experience the minimum amount of preliminary information which a therapist should possess for such guidance may be supplied by a ten page autobiography, an hour of relaxed reminiscing about childhood experiences and fantasies, the thematic apperception test and an hour of direct questioning. Of these, the thematic apperception test is frequently the most helpful, for it brings to the forefront just those underlying issues which are of immediate consequence.

At the present time a young person who shows a few mildly neurotic symptoms or, like all inwardly developing persons, is temporarily overburdened by mental conflict generally has, if he wants expert assistance, but two choices. He may be analyzed, or he may consult a psychiatrist with no experience in analysis. This is the case because most trained analysts are apt to limit their practice to complete psychoanalyses. There are numberless young men and women who need the kind of help which perhaps only a therapist trained in psychoanalysis is in a position to give and yet who do not need, or want or cannot afford an analysis lasting for a year or more. They need to confess, to discuss their problems, to attain insight, but in most cases it is better for them not to impede their progressive efforts by having to revive and relive their past. It is in such cases that the thematic apperception test may provide the psychotherapist with the information necessary for the fulfilment of his function as a guide and healer of men.

## PSYCHOLOGIC AND PHYSIOLOGIC PHENOMENA DURING A PROLONGED VIGIL

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Disturbances in the rhythm of sleep and the effect of these disturbances on personality have been of interest to psychiatrists and psychologists for many years. Despite the experimental work which has been reported on the subject there is little accurate knowledge concerning the essential basis of the phenomena of sleep or concerning the real effects of disturbances of the rhythm of sleep. Stories concerning death produced by continued wakefulness or of mental disease produced by long vigils have been current for many years. There are, however, no actually observed cases recorded in the medical literature which clearly indicate that extended vigils produce either mental disease or death.

Normal sleep is disturbed in various organic conditions of the central nervous system, such as encephalitis, meningitis, concussion and dementia paralytica, as well as in the functional psychoses, in manic-depressive psychosis and in schizophrenia. This demonstrates clearly that an intact nervous system does not of itself suffice for the normal function of sleep but that sleep is also psychologically conditioned. As far as we know, no definite investigations have been carried out to determine the nature and extent of somnolence or insomnia in the psychoses.

Table 1 summarizes briefly the more relevant experiments conducted during the past forty years which bear on the physiologic and psychologic effects resulting from a deprivation of sleep.

In general, it has been shown that vigils extending from eighty to one hundred and fifteen hours have little effect on physiologic functions that have been measured. No significant deviations in the chemistry, cell count or  $p_H$  of the blood have been clearly shown. It has been found by several investigators that the chemistry of the blood showed a greater lability or changeability than that in normal persons. No significant changes in the temperature, pulse rate, respiratory rate or metabolism have been demonstrated. With respect to the effect of deprivation of sleep on the responses to simple mental tests, all inves-

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TABLE 1.—Major Points of Psychologic Interest Brought Out by Various Previous Experimental Vigils and a General Summary of the Findings

Author	Year	Hours of Wakefulness	Subjects Used	Effects on Response to Motor Tests	Effects on Response to Simple Mental Tests	Effects on Response to Complex Mental Tests	Disturbances Reported	Amount of Sleep Needed to Recover
Patrik, G. T. W., and Gilbert, J. A.: <i>Psychol. Rev.</i> <b>3</b> : 469, 1896	1896	90	1	Slight loss on dynamometer; increased reaction time	Discrimination regular or improved; fewer letters named	In one subject, great loss in ability to memorize figures	Marked hallucinations in one subject	16%, 27% and 35% of total lost
Smith, M.: <i>Brit. J. Psychol.</i> <b>8</b> : 327, 1916	1912-1915	22½ 20½ 18½	1	Increased dotting score	Power of association improved	Better results during vigils	.....	Some extra
Robinson, F. S., and Herrmann, S. O.: <i>J. Exper. Psychol.</i> <b>5</b> : 19 and 35, 1922	1922	60-65	3	Dynamometer, none Tapping, none Aiming, none	Reading of letters improved	Errors greater in mental multiplication	Increased emotional instability; some hallucinations	Usual amount of sleep sufficient for recovery
Kleitman, N.: <i>Am. J. Physiol.</i> <b>66</b> : 67, 1923	1923	11½ 50	1-1 4(?)	.....	Negative results on naming of letters	In lectures, difficulty in taking notes, then impossibility; laboratory work normal	Irritability; semi-dream states; hallucinations	
Laslett, H. R.: <i>J. Exper. Psychol.</i> <b>7</b> : 45, 1924	1924	50	3+2	.....	No significant changes in code substitution	Negative results in analogies tests		
Moss, F. A.: <i>George Washington Univ. Research Bull.</i> <b>1</b> : 1, 1925	1925	60	5(?)	Difficulty in driving automobile	Improvement in checking license numbers on automobiles; no deficiency in recognizing opposites	Improvement in army alpha test; difficulty in driving automobile	Some hallucinations	Deliberately varied from 7 to 12 hours
Weiskotten, T. J., and Ferguson, J. E.: <i>J. Exper. Psychol.</i> <b>13</b> : 247, 1930	1930	66	3	None apparent	Loss of speed in code substitution	Loss of speed in mental multiplication but greater accuracy	Headaches; nervousness; hallucinations	Little or none beyond ordinary
Herz, F.: <i>Arch. f. d. ges. Physiol.</i> <b>260</b> : 426, 1923	1923	80	1	.....	No effect in repeating numbers and syllables	Occasional difficulty in reading	.....	14 hours to spontaneous awakening
Laslett, H. R.: <i>J. Exper. Psychol.</i> <b>11</b> : 376, 1928	1928	72	5	Some loss shown by pursuit meter	Loss in code substitution	Marked change in score of Thorndike test	.....	Usual
Summary of experimental findings		Vigils as long as 115 hours		Both loss and gain in ability slight	Ambiguous; generally slight gains or losses	Ambiguous	Hallucinations; irritability; emotional instability; ocular pains; headaches; nervousness	Generally very small percentage of lost sleep made up

tigators have reported a slight or insignificant interference with function. In the more complex mental tests the results are somewhat conflicting. Some persons have shown interference with such functions as mathematical computation or the solution of complicated mental tests; others have failed to show such changes. Practically all investigators reported that visual or auditory hallucinations occurred after two or three days of wakefulness. In general, however, the work shows that vigils prolonged to one hundred and fifteen hours have little effect on either the physiologic or the psychologic processes of the subject. The only constant phenomena reported are hallucinations, irritability, emotional instability and ocular discomfort and strain during reading. Practically every investigator has reported that his subjects recovered quickly when allowed to sleep for eight or ten hours.

#### EXPERIMENT

In January 1933, a young man, Z, introduced himself to us with a remarkable request. He was convinced that sleep is a habit which custom is constantly reenforcing in the lives of all persons and that with proper procedures this habit could be broken. He claimed that on several occasions he had gone without sleep for four or five days. He requested that if it were possible to make arrangements for such an experiment he might try to demonstrate that the habit of sleep could be broken. He believed that if for more than a week he could be under constant supervision and receive the stimulation afforded by agreeable companions, he would be able to overcome the ill effects and unpleasantness attendant on the breaking of the habit. He expected that at some time after a week of abstinence from sleep he would get a "second breath," and from that time on would be able to stay awake twenty-four hours a day without difficulty or effort.

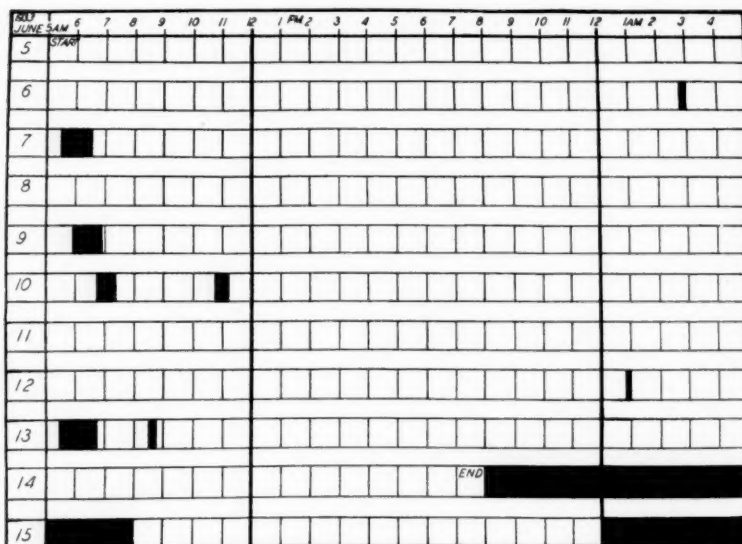
For several reasons we tried to discourage him, but as he insisted, we directed him to practice writing on a typewriter for a period of thirty minutes daily, marking the typing at the end of each minute of work. We also suggested that he practice a code substitution test. These tasks, if thoroughly mastered, should offer a measure of the effect of sleeplessness on the mental functional ability. After the typing and code practice had reached a constant level of efficiency we arranged for the experiment.

A physical examination showed that the subject was of a pyknic habitus, in excellent physical condition, with no evidence of gross organic disease; the neurologic examination gave negative results. His behavior and dress were somewhat eccentric. His age was 24 years.

In order that we might have a clearly reliable check of whether or not Z was really awake, we arranged for him to carry with him at all times during the vigil a watchman's recording clock and key. The turning of the key in the clock

at intervals of ten minutes registered the fact that he was awake. Z personally made arrangements with a group of his friends, so that after the first night he was on every occasion accompanied by some friend or relative.

The chart shows the periods of inadvertent sleep which occurred during the two hundred and thirty-one hours which constituted the vigil. These periods of sleep were fifteen, sixty-five, sixty, thirty-five, thirty, forty and seventy minutes, making a total of three hundred and fifteen minutes (five and one-fourth hours) of sleep during the period. In every instance the sleep was accidental. The naps usually occurred as follows: Z would sit down to read after a conversation or a walk. His companion would leave him for an hour or so, believing that he was wide awake and showed no signs of drowsiness. Later Z would suddenly awake realizing that he had been asleep rather than awake and reading. The length



Graphic representation showing the periods of inadvertent sleep (black rectangles) which occurred during the experimental vigil of Z.

of the period of sleep was determined from the clock record. The longest period of absolute vigil was sixty-two hours.

*Results of Tests.*—Table 2 summarizes the data obtained from all the various physiologic and psychologic tests that were made during the vigil. It will be noted that the weight remained practically constant. There was little variation in either the pulse rate or the blood pressure. The effect of exercise on blood pressure was no different from that obtained in the usual waking state when sufficient sleep has been secured at regular intervals. The basal metabolic rate was several degrees lower on the last day of the vigil than on the first. However, this change is well within the limit of the probable error of the measurements. There were no significant variations in the blood count.

The department of biochemistry carried out the determination of certain chemical constituents in total twelve hour specimens of urine. No significant deviations were noted during the period of the experiment. Previous investigators



TABLE 2.—Daily Findings in Certain Physical, Chemical and Psychologic Tests Administered to Z During His Experimental Vigil

Day of Experiment	Minutes of Sleep in 24 Hours	Weight, Kilograms	Pulse Rate	Blood Pressure Before Exercise	Blood Pressure After Exercise	Basal Metabolic Rate, Percentage	Red Blood Cells	White Blood Cells	Urine*					Army Alpha Intelligence Test	Otis Intelligence Test	Tapping Test, Right Hand	Tapping Test, Left Hand	Test with Dynamometer, Right Hand	Test with Dynamometer, Left Hand	Number of Words Typed in Five Minutes	Typing in Five Minutes	Threshold of Visual Acuity in Right Eye, Foot-Candles	Threshold of Visual Acuity in Left Eye, Foot-Candles	Auditory Threshold, Decibels
									Volume, Liters per 12 Hours	Preformed Creatinine, Gm. per 12 Hours	Creatinine, Gm. per 12 Hours	Inorganic Phosphorus, Gm. per 12 Hours	pu											
6/ 5/33	0	73.30	72	132/ 90	.....	.....	4,000,000	6,500	.....	.....	.....	.....	.....	194	130	107	110	130	155	103	47.8	.....	.....	..
6/ 6/33	0	.....	..	.....	.....	.....	.....	.....	0.45	0.50	0.01	0.56	5.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..
6/ 7/33	80	.....	..	.....	.....	.....	.....	.....	0.70	0.97	0.15	0.59	5.1	.....	.....	116	111	182	140	82	24.1	0.156	0.157	43
6/ 8/33	0	.....	..	.....	.....	.....	.....	.....	0.31	0.72	0.06	0.34	5.1	.....	.....	116	115	190	170	65	46.0	0.095	0.098	47
6/ 9/33	60	72.30	72	142/ 84	.....	.....	.....	.....	0.38	0.91	0.20	0.63	5.0	.....	.....	124	117	190	150	...	.....	0.157	0.178	46
6/10/33	65	72.28	..	.....	.....	.....	.....	.....	0.20	0.74	0.08	0.32	4.9	.....	.....	128	123	190	170	...	.....	.....	.....	45
6/11/33	0	.....	68	.....	100/ 80	.....	.....	.....	0.33	0.99	0.04	0.62	5.0	.....	.....	113	117	190	150	...	.....	.....	.....	..
6/12/33	40	.....	72	148/108	100/110	.....	.....	.....	0.47	0.91	0.05	0.55	5.1	.....	.....	122	116	190	145	...	.....	.....	.....	47
6/13/33	70	73.20	72	128/ 95	132/ 95	—4	4,000,000	5,000	0.32	0.50	0.05	0.18	5.1	.....	.....	118	119	165	140	...	.....	.....	.....	65
6/14/33	0	73.0	72	.....	.....	.....	.....	.....	0.89	1.42	0.28	0.82	5.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54

\* The first figure in the daily pairs represents the sample collected between 7 a. m. and 7 p. m.; the second figure, the sample collected between 7 p. m. and 7 a. m. Z was not on a meat-free diet; therefore the figures do not show the true amount of preformed creatinine.

have reported that the excretion of creatinine is lower during the period of nocturnal sleep than it is during the waking day. There was little difference between the rate of excretion of creatinine during the day and that during the night in this experiment.

In intelligence tests, in which equivalent forms of the same examination were given on the second and on the seventh day of the vigil, practically no difference in level was found. With both tests Z made high marks. It is probable that the tests were too easy, since he achieved the maximum score on several subtests. Had the tests been more difficult, differences might have been observed which could be attributed to the vigil.

No significant differences were shown by either the tapping test or the test with a dynamometer. The tapping test, which is essentially a measure of the speed of reaction, gave remarkably constant results during the period of the experiment. The measurements with the dynamometer, which offer an index of the strength of muscular contraction, were also remarkably constant. There was a slight decrease on the last day of the experiment, but this was probably a chance variation and is not to be attributed to the loss of sleep.

On the four days preceding this experiment, Z typed an average of 149, 126, 109 and 127 words, respectively, in five minutes. In writing these words he made 40, 27, 21 and 31 errors in five minutes. By comparing these figures with those in the table for the first four days of the experiment it will be seen that there was a decrease in the number of words typed in five minutes and an increase in the number of errors. The average number of words typed in five minutes for the four days preceding the experiment was 127, with 30 errors. The average number of words typed in five minutes during the first four days of the experiment was 87, with 43 errors. After the fourth day Z was unable to carry on this part of the experiment. It became impossible for him to fixate the printed page from which he was copying. He stated that the pain from his eyes was tremendously exaggerated by any attempt to read with artificial light, and he complained of an inability to fixate the printed material as is necessary in type-writing. It is probable that the gradual decrease in efficiency in typing during the first four days of the experiment is to be attributed to fatigue of the visual mechanism. Visual activity was the one form of reaction in which it was impossible for Z to obtain occasional rest. As soon as he closed his eyes to rest them or whenever he sat in a dark room he immediately fell asleep. Hence it was necessary for him to keep his eyes open and to remain in illuminated surroundings.

Tests of stimulus threshold for visual brightness were made on the third, fourth and fifth days of the vigil. The limen during the vigil averaged 0.130 foot-candles, while for three days, three weeks after the end of the vigil, the limen was 0.035 foot-candles. It is impossible to state whether this increased variability and increase in absolute limen depended on the fact that the measurements were made in a dark, quiet room, which accentuated the tendency toward sleep, or whether the increased variability reflects an increase in the instability of the nervous system resulting from the effects of the vigil. The level of the auditory limen as determined three weeks after the vigil was 52 decibels. Table 2 shows that the level of the auditory threshold on the third, fourth, fifth, sixth and eighth days ranged between 43 and 47 decibels, figures significantly lower than the "normal" limen of the subject. The limen on the ninth day was 65 decibels, and on the tenth, 54 decibels. No clear explanation is at hand to account for these figures.<sup>1</sup>

1. Measurements of the stimulus threshold for visual brightness were made by Mr. F. C. Thorne and of the auditory threshold by Miss Marion Bartlett.

*Behavior as Observed During the Vigil.*—Z showed no observable differences in behavior during the first five days of the test. Starting with the sixth day there occasionally occurred isolated manifestations of behavior which we interpreted as evidence of spatial disorientation.

On one occasion when Z was asked what street corner he was on, he gave a location four blocks away from his actual situation. At another time he arose suddenly and walked to a desk which he mistook for a drinking fountain. On still another occasion he arose suddenly and walked down a corridor, trying every door as he passed. He explained this by saying that he thought he was on a different floor and was hunting for the room to which he had been assigned. He stated that these instances, which we regarded as evidence of disorientation, were more or less usual occurrences in his every-day behavior. This may be true, but we believe that the disorientation was exaggerated beyond that which he habitually showed.

To facilitate his carrying out the vigil it was thought best that he be amused or allowed to amuse himself without undergoing any unusual physical fatigue. During the vigil he took many long walks and on several occasions played ping-pong. He did not at any time complain of physical or mental fatigue. Neither did his behavior indicate that he was suffering from fatigue at any time. The weather during the period of the vigil was unusually warm, so that it was much easier to be quiet than to indulge in any strenuous activity. Evidences of mental fatigue which one might have expected to observe did not occur. On every occasion when the mental stimulation or the situation required extra effort, the subject put forth that effort and made an acceptable adjustment to the situation. The one exception to this general lack of fatigue is the visual fatigue mentioned.

After the fifth day there became evident a marked increase in irritability and a decrease in the subject's usual emotional control of reactions of anger. This may have been due partly to the weather and to the increasing familiarity between the subject and those who kept him under observation. However, there was no doubt in the mind of any one associated with him that he was increasingly touchy and irritable toward the small pinpricks of every-day existence. He broke forth in a tirade when his wishes were thwarted or when he thought that something had occurred which was making the experiment more difficult for him. It became increasingly difficult to get him to accept any suggestions concerning the conduct of the experiment or of himself. The combination of the irritability and disorientation gave a total picture of personality similar to that of a person who when mildly intoxicated is irritable, irascible or argumentative.

*Mental Status.*—On several occasions during the vigil Z reported hallucinations and hypnagogic images. These occurred particularly during the crystal-gazing which was used during a part of the determinations of the auditory thresholds. He reported these phenomena to the experimenter as follows:

On the third day he saw a cottage by a beach, then other houses. He saw a man trying to burglarize one of the houses. The imagery was very vivid in the crystal.

On the fourth day he saw a missionary in a roast pot with his knees hanging over the edge. The image turned into an old man in a bathtub with his knees hanging over. Then he saw a boy with cheeks puffed out giving a Bronx cheer. He had a hallucination that I tapped my hand between him and the crystal. He had visual hallucinations all day.

On the fifth day he saw in the crystal a transatlantic whale with a square face. Then he saw very clearly two boats sailing across together. Most of the time he was in a daze and was hardly aware of my activity.

On the sixth day he was unable to report a single image during the period of crystal-gazing.

On the ninth day he was able to think only in fragments and had reminiscences. He saw several soap dishes, but he looked away most of the time.

On the tenth day he was unable to report a single thought or image.

As has already been mentioned, on several occasions Z was disoriented, and in this disorientation he accounted for his actions on a basis which would justify an observer in concluding that he had hallucinatory delusions. The incidents of mistaking the desk for the drinking fountain and one corridor for an entirely different one in the hospital are examples of this.

During the course of the vigil Z formulated a delusional system, attributing persecutory intent to one of the experimenters. He became more and more certain that this experimenter was personally interested in making life disagreeable for him and in interpreting his behavior in terms of pathologic mental mechanisms. These tendencies became so marked during the last two days of the vigil that they formed the principal basis for our decision to discontinue the experiment when we did. His protests and misinterpretations of motives and conduct became increasingly marked to an extent which made him more and more unmanageable and occupied more and more time and attention of all connected with the experimental laboratory. Six months after the end of the experiment Z still retained part of the system of ideas concerning this fancied persecution. At that time he was able to discuss the matter in a more factual way and without the incoherence and physiologic concomitants which he exhibited during the last two days of the experiment.

On the last day of the experiment Z composed the following verse directed to two of the women who had assisted in the observation during the experiment. The verse, together with his explanation of the first two lines, is as follows:

"F unctions that hamper and gifts that requite  
M ust, by their nature in women unite.

R eckless compounding of accent with flush  
A ttacks like a limen, basic in hush  
A ttacks in the crystal, survives in the light  
R ecoils and assembles 'twixt mystic and trite.

N ew fashions go leering, old modesties blare  
I comin the springtime, their tortoise shell dare:  
O ver insistence, and collect what you may  
E voke pleasures of night to sustain in the day.  
N orthward the lust and the yearning conspire  
S weet south, how delightful sensed form to attire."

"The rim is composed of a woven acrostic of the two names. The first couplet sets the general theme, that women and possession are not an unmixed blessing, that the fact that as women they must require things of men that set the men from the progressive work they as men set themselves, that moreover the women might be finer things if the racial needs that lurk in their smiles and frowns, supplenesses and awkwardnesses did not compel them, their own insight lacking, to demands of this delaying sort. The hampering and the functions thus are on several levels of operation, and poetry, to the proper reader conveys much of this, more besides, and epitomizes the fact in addition."

It must be admitted that, although the general intent of the poem is at times obscure, the actual composition indicates mental integration and integrity even at this period of sleeplessness. It is the best evidence we have that offers definite proof of lack of impairment of higher mental functions at the end of the vigil.

#### COMMENT

All the results of this experiment must be considered in the light of the general personality of the subject who would and did undertake such an experiment. It seems to us that in all probability the general mechanism back of Z's motives was that of demonstrating his uniqueness by attempting a type of activity which no one else would consider trying. By going without sleep for a prolonged period he would establish himself in the unique position of a man who could do one thing better than any one else in the world. He further rationalized this by believing that such a demonstration would be of immense value to the human race, since it would add at least a third more time to the life of every one who would go to the trouble of breaking the habit of sleep as he proposed to do. Having firmly convinced himself of this value, there was never at any time during the experiment any complaint with respect to the effects of the loss of sleep or to the effect of fatigue. He insisted always that he felt well and was wide awake. He insisted that he was always in full command of his faculties and was not suffering from any loss of either mental or physical capabilities. His complaints and irritability were directed in every instance toward persons or circumstances which he said were working against the effective demonstration of his experiment.

In general, there was no clear, indisputable evidence that the vigil produced any effects on the mental life of this subject which could be unqualifiedly attributed to the lack of sleep. Every change which we have remarked on can in a way be reasonably viewed and explained on the basis of the general personality and character of the subject.

#### SUMMARY AND CONCLUSIONS

The physical and physiologic findings as to the effect of a ten day vigil are essentially negative. There is no evidence of any real change in physical or physiologic function which can be attributed to the period of sleeplessness. The tests of motor function and of mental acuity gave negative results. With the exception of tests which depended on visual acuity, no impairment of general efficiency was demonstrated. The basic limen of both vision and audition was somewhat increased both as to level and as to variability.

The higher functions of organization and synthesis of mental life appeared to be somewhat affected. The general picture was that of a slightly intoxicated person who had grown irritable, argumentative and was occasionally slightly disoriented in time and space. Hallucinations,

hypnagogic images and a delusional system occurred and can be attributed to the precipitating effect of the lack of sleep.

Owing to the desire of the subject to demonstrate that sleep was not necessary, there never occurred any complaint against the rigors of the experimental situation. At all times he was perfectly willing to demonstrate that he was wide awake and that he could do as well in any test of mental or physical function as he had been able to do before the experiment started.

In general, it has been demonstrated that in this case it was possible to go with practically no sleep for approximately ten days without any known physiologic effect and without any permanent change in the personality or in the mental function.

#### ABSTRACT OF DISCUSSION

DR. C. O. CHENEY, New York: When the question of the experiment came up, I, as administrator, was placed in a difficult position as to whether it would be wise for us to allow and take part in an experiment such as this, with a subject who, to say the least, was definitely eccentric. I was concerned, of course, as to what permanent changes might take place in his mental condition if he went without sleep too long. In view of the facts that he insisted on doing it and we obtained a signed release from him and his father's consent, relieving the hospital and ourselves of all responsibility, we proceeded with the experiment.

He has made a record. He has not made the record he hoped to make. His motive as well as the reason for his being able to carry on as long as he did was that he was trying to show that he could do something nobody else had ever done; in that way he was trying to elevate his own ego. Apparently no permanent deleterious results have followed the experiment.

The characteristics of personality were, I think, accentuated during the period of vigil and persisted for some time, not because of the effects of the vigil but because of the defeat he had suffered in not being able to prove that he could go indefinitely without sleep, and he was inclined to blame the failure on some of us who insisted on terminating the experiment.

This brings up the question of the seriousness of loss of sleep in patients. One frequently sees patients with depressions particularly of the manic type, who go for long periods with apparently insufficient sleep, and do not seem to suffer great harm.

The experiment that Dr. Katz and Dr. Landis have presented shows that a person may go for a period of two hundred and fifty hours without obvious physiologic change, without permanent effects on his personality and without a marked psychosis due to exhaustion and the toxic reaction that one would expect.

DR. LLOYD H. ZIEGLER, Albany, N. Y.: The unusual study of Dr. Katz and Dr. Landis puts on record the observations, including the results of clinical and psychologic tests, on a subject who slept little in ten days to test his own theory about sleep as a habit.

I am not surprised that the psychologic tests showed so little effect of the lack of sleep. Those tests are too simple for testing the variations that might occur in many of the human functions. The physiologic processes of the subject seemed to be little affected by the experiment. However, in the realm of acuity of the sense organs and of subjective feelings associated with ocular movements,



changes were noted. After all, the "sandman" that afflicts the children who rub their eyes when they become sleepy is probably not a myth.

The most interesting developments in the experiment were the tendency to visual hallucinations, the disorientation, the suggestion of irritability and the defensive misinterpretations, really considerable steps in the direction of a psychosis of the toxic or delirious reaction type. Except for some persistence of the delusional trends, all these symptoms disappeared after a period of sleep.

The study is interesting in that it suggests an experimental approach to the production of psychopathic phenomena. How much loss of sleep different persons might endure before manifesting psychopathic symptoms would doubtless prove an interesting study. It is possible that one might measure psychobiologic integrity by the number of hours one can go without sleep before psychopathic symptoms appear.

Sleep is an interesting biologic function which seems to be favored by certain postures and is associated with a slight change in temperature. Kleitman and his associates have shown that decorticated dogs have several periods of sleep instead of a prolonged one. The epidemics of encephalitis of the last decade or two have aroused a new interest in sleep. Tumors or lesions of the third ventricle and hypothalamic region are associated with an increase in the function of sleep. Narcolepsy has emphasized the relationship of sudden attacks of sleep and certain changes in muscular tone associated with emotional experiences. Sleep is to some extent within voluntary control, as this and other studies have shown. The desire for sleep may be an affective or emotional state that could obey some of the laws of conditioned reflexes. In general, the patient's willingness to associate sleep or failure to sleep with various affective states complicates the probability of understanding either of them very well.

Clinically, one sees unusual things in relation to sleep. Some patients are so easily stimulated that sleep becomes impaired. These patients provide their own stimulation, once activated. Other patients are obsessed by the fear that they will not sleep but sleep soundly all night. The dreams and *pavor nocturnus* of some are so unpleasant that they prefer to remain awake.

In health, sleep is fairly separate from wakefulness, and the zone from one to the other is reasonably narrow. However, one sees in some patients evidence that this zone is less distinct and that the phenomena of sleep and wakefulness are somewhat mixed.

In general, the problem of a prolonged vigil may be comparable to that of a prolonged fast, to depriving the person of a considerable quantity of the necessary supply of oxygen or possibly to lowering the amount of sugar in the blood to a very low level. Consequences must arise, as have been demonstrated, which doubtless depend on the various factors that make up the total person.

This study demonstrates that a study of sleep as a physiologic function is no less important than the study of the urine, of the blood or of electrocardiographic tracings in attempts to understand the possibilities of human life.

DR. SIEGFRIED E. KATZ, New York: We realize the psychologic tests were not sufficiently difficult, but we had to select tests which were sufficiently standardized to have various forms for use on different days.

Time did not permit us to present a review of the literature as to the function of sleep in normal and in abnormal subjects. We found that little has been reported on the rhythm of sleep in the psychoses. Another study made at the Psychiatric Institute indicates that in the catatonic form of *dementia praecox* sleep is not disturbed. We are extending our studies of sleep to other forms of psychoses.

## INVOLUNTARY GRAPHIC SPRAWL

A MOTOR PHENOMENON RELATED TO MIRROR-WRITING AND MODIFIED  
BY THE FACTOR OF HANDEDNESS

CLARENCE QUINAN, M.D.

SAN FRANCISCO

Mirror-writing, whether produced by movements of the right or of the left hand, may be defined simply as script that runs in a counter-clockwise direction. An early example of such writing is found in the well known report that Leonardo da Vinci habitually wrote in this reversed fashion and that most of his anatomic sketches exhibit marginal annotations written from right to left; indeed, on the strength of this evidence it has been assumed that the master was left-handed. This conclusion, however, appears to be by no means an inevitable one, as experience seems to show that not a few dextral persons through secret practice acquire the faculty of being able to produce reversed script with the right hand.

Because it constitutes a borderline problem, interesting alike to medical men and to psychologists, this graphic peculiarity has been the subject of an extremely copious literature. Useful working lists of the more important papers on mirror-writing are now available; among others, the reader is referred to those published by Fuller,<sup>1</sup> by Blom<sup>2</sup> and by Carmichael and Cashman.<sup>3</sup>

In the course of a search through the general literature on the subject undertaken primarily with a view to ascertaining what type of configuration, if any, was characteristic of reversed writings, it was noted in every instance, so far as a central reversing mechanism was concerned, that the specimens of writing displayed seemingly had been produced through the agency of a single driving center, whether a left or a right one. But at the same time, although no samples of their work were submitted, some evidence was found which seemed to show that some persons possessed the rare faculty of being able to produce mirror-writing by means of simultaneous, bimanual movements in which each hand moved in a centrifugal direction, that is to say, away from the center line of the body. On consideration of these two findings from a

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1. Fuller, Justin K.: *The Psychology and Physiology of Mirror-Writing*, Univ. California Publ. Psychol. **2**:199 (May 8) 1916.

2. Blom, Edward C.: *Mirror-Writing*, Psychol. Bull. **25**:582, 1928.

3. Carmichael, Leonard, and Cashman, Helen: *A Study of Mirror-Writing in Relation to Handedness and Perceptual and Motor Habits*, J. Gen. Psychol. **6**:296, 1932.

dynamic point of view, the following hypotheses were elaborated: 1. With respect to the first type of mirror-writing (unimanual) it is surmised that a single motor discharge streams downward through the internal capsule but that before it issues from the cortex it is reversed by an effort of the will in one or the other of the two writing centers. 2. Regarding the second type of mirror-writing (bimanual) it is believed that two motor discharges are concerned—one from each cerebral hemisphere—and that both of these discharges pass directly to the periphery, for centrifugal writing movements appear to be quite as normal for the left hand as they are for the right.

In regard to the dynamics of unimanual handwriting I had already accumulated some experimental data before the observations herein reported were made. Since they appear to be of collateral interest, and since I shall not return to this subject later, it seems appropriate to review these data briefly in passing. Fair examples of normal script and of reversed script—both written with the right hand—are shown in figure 1. The two persons who wrote the sentences depicted in figure 1 were dextrals—one of the type RR, the other of the type RL.<sup>4</sup> The time required for writing each of the four samples exhibited was determined by means of a stop-watch, while the lineage records were ascertained with a millimeter rule. A comparison of the respective data shown in figure 1 reveals that the amount of time required for producing the specimens of reversed writing was approximately twice as great as that consumed in completing the normal ones and that the lineage values of the mirror-writing were much greater than those of the specimens written in the usual way. In one specimen the difference in the lineage values amounted to 34 mm.; in the other it was 61 mm.

Mettler<sup>5</sup> seems to have been the first to describe a case of bimanual handwriting. In fact, only two other pertinent contributions appear to have been published—one by Bramwell<sup>6</sup> and one by Critchley.<sup>7</sup>

Concerning the technic of bimanual handwriting, Bramwell expressed himself as follows:

If one takes a pencil in each hand and then writes simultaneously with the two hands on a sheet of paper, it will be found that one writes from left to right with the right hand and from right to left with the left hand—one writes outwards from the centre of the body with each hand. And if one compares the two writ-

4. "RR" denotes right-handed and right-eyed; RL, right-handed and left-eyed; LL, left-handed and left-eyed; LR, left-handed and right-eyed.

5. Mettler, L. H.: Exhibition of a Case of Ambidexterity and Mirror-Writing, Chicago M. Rec. **26**:617, 1914.

6. Bramwell, B.: Clinical Studies: XIV. "Crossed" Aphasia; Mirror-Writing, Edinburgh M. J. **20**:220, 1918.

7. Critchley, Macdonald: The Significance of Mirror-Writing, Proc. Roy. Soc. Med. (Sec. Neurol.) **20**:25, 1927.

ings—if one is able to write easily in this way with the two hands—it will be seen that they are absolutely identical—the “mirror”-writing (written with the left hand), if reversed and placed, for the purpose of comparison, above the writing written with the right hand, is found to be identical, stroke for stroke, with the writing of the right hand. If one is an expert in this way, with the right and left hands simultaneously, and one makes a series of flourishes and curves, every curve and flourish will be found to be identical in the two writings. This seems to show that the motor discharge which produces the movements necessary for the act of writing is identical in character on the two sides of the brain (in the two hand

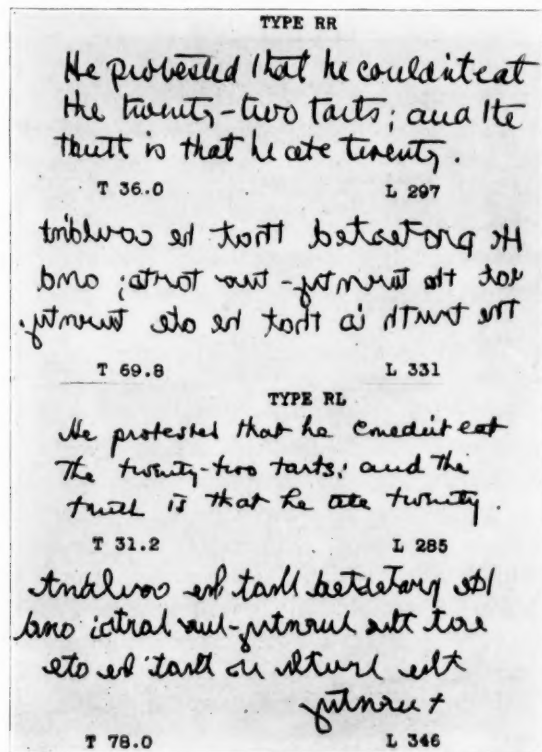


Fig. 1.—Specimens of normal script and reversed script produced with the right hand by two dextrals, one of the type RR and one of the type RL. *T* indicates the time in seconds, *L*, the linage value in millimeters.

centres). Presumably, therefore, both motor discharges are stimulated and governed from the same sensory centre, which, in right-handed persons, is presumably situated in the left, and in left-handed persons in the right, hemisphere.

Since I had found (fig. 1) by means of linage measurements on a standard test sentence that normal and reversed script produced unimanually with the right hand by a dextral differed considerably from one another with respect to the factor of linage (energy output?), it

seemed worth while to study by similar means paired specimens of bimanual writing obtained, respectively, from dextrals and from sinistrals. This article describes briefly some of the results noted in such a study. The first experiments of this sort were carried out with a group of illiterate employees in factories. At the conclusion of this work I had at my disposal 40 paired specimens of handwriting, each one written with the right and the left hand simultaneously. Of these specimens of script, 34 were obtained from right-handed and 6 from left-handed persons. On inspecting this collection of specimens, it became obvious at a glance that the forms of the letters in each, particularly in those produced with the right hand, presented the remarkable spread-out appearance to which I have applied the term "graphic sprawl."<sup>8</sup> Furthermore, on comparing the specimens of bimanual writing of the dextrals with those of the sinistrals, it seemed to me that these writings displayed, in a linear sense, at least, a sort of isomorphism, in that one set appeared to be roughly the reversed counterpart of the other. In other words, the evidence in hand seemed to show not only (1) that all the specimens exhibited the characteristic sprawl phenomenon but (2) that there appeared to be right and left isomorphic types of bimanual sprawl.

On the strength of these findings, it was assumed in regard to the basic cause of the sprawl phenomenon: (1) that two motor discharges were concerned—one from the preferred and one from the nonpreferred writing center; (2) that these motor discharges probably were of unequal intensity; (3) that they reacted on one another—presumably through commissural connections, and (4) that, in some unknown manner, this reaction had the effect of disorganizing the handwriting movements.

The foregoing theoretical considerations seemed to indicate that, in order to be of value for practical purposes, each sample of script studied should exhibit at least five copies of a selected test word, namely, as a basis for comparison, a copy of the test word written in the reactor's customary style and therefore produced while the preferred writing center was in its normal and relatively undisturbed state, and two paired copies of the test word written with the right and the left hand simultaneously.

This plan of procedure was tested out in two series of experiments. In each series samples of bimanual writing were obtained from 100 persons. The test word used in the first series was, in every instance, the reactor's given name. This word was chosen as being one that each subject would be able to dash off almost subconsciously. For the purpose of studying the qualitative peculiarities of graphic sprawl the

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8. The term "sprawl" denotes ". . . to spread ungracefully, as chirography" (Webster).

records so obtained proved of service; but, of course, the lineage values to be obtained from such specimens were useless for statistical purposes. For this reason, all the samples of writings secured in the second series were based on the standard test word "Halliard." Explanatory comments as to why this word was selected are offered elsewhere in this article.

The qualitative data obtained in the first and the lineage data obtained in the second series of experiments are presented later. Before these two sets of data are introduced it is necessary to describe (1) the working material on which the data were based and (2) the technical procedure employed in the experiments.

#### MATERIAL

Of the total number of 200 persons studied in the two series of experiments 115 were men, and 85 were women. As these persons were tested without regard to the factors of age and social condition, the general group was a mixed one. But all the persons who took part in the work seemed to be alert and intelligent, and except in a few instances they seemed to be fairly proficient in the art of penmanship. It should be mentioned that 105 of the samples of writings were obtained from students of art. This circumstance explains in a large measure why of the total number of 200 specimens collected no less than 29 were written by left-handed persons, 17 of whom were left-handed and left-eyed and 12 of whom were left-handed and right-eyed. It should be remarked in this connection, however, that since the main object of this research was to find out whether there was a relationship of any sort between the sprawl phenomenon and a laterality factor, samples of bimanual handwriting were secured from sinistrals whenever favorable opportunities made it possible to examine such persons. It is perhaps not superfluous to add, finally, that not a single subject was found who was unable to carry out the simple writing test.

#### TECHNIC

For the purpose of collecting samples of script, three items of equipment were used (1) a pocket note-book with leaves about 9 by 15 cm., (2) a sheet of carbon-paper of the same size and (3) two lead-pencils. With these articles a typical writing test was carried out as follows: when a page of the note-book had been arranged before the person to be tested so that the left lateral half of the page was placed over the sheet of carbon-paper and when the person had assumed a posture convenient for writing, he was asked to write the required test word on the sheet of paper—near the top of its right lateral half—and to do this in his usual style of writing. When the test word had been written the person took up a pencil with each hand and was requested to copy the test word with the right and left hands simultaneously. If then, as commonly happened, he raised the objection that such a procedure was impossible, it was explained to him that any person could write in that fashion; that if he applied his will to the accomplishment of the task, the necessary movements would take place of themselves; that all he had to do was to adjust himself to the idea that his hands were to move simultaneously away from the midline of his body and that, without any particular attention on his part, the movements of the left hand would almost automatically follow those of the right. He was instructed also to write the test word twice in succession in such a



manner that the second pair of words—the left and the right word, respectively—would lie directly below the corresponding word of the first pair. Of course the carbon-paper was used for the purpose of obtaining reversed impressions of the writings produced with the left hand. Finally, on completing the test, suitable notations in regard to the formula of the subject's handedness and eyedness were entered on the finished specimen.

Apparently a majority of the persons examined produced the required bits of script without any special effort. However, there were exceptions to this rule. It was noted that the test seemed to exert a disturbing influence on some of the persons tested. Most commonly this disturbance expressed itself in the form of a motor singularity of one sort or another, but in one instance it seemed to manifest itself in the form of a psychic reaction. In passing, therefore, it will be convenient to give a brief account of these motor and psychic reactions.

#### UNUSUAL MOTOR AND PSYCHIC REACTIONS

Mastery of the volitional effort necessary in order to pit the activities of one writing center against those of the other, as required in the act of writing with the right and the left hand simultaneously, was exhibited in varying degrees by the persons examined in the course of this study. In some instances, for example, it was noticeable, as regarded the movements of the left hand, that often instead of breaking away promptly to the left the point of the pencil tended to move up and down in one plane or to bend back in a dextrad direction as though irresistibly drawn to the right. But in other instances, as shown by the presence of sporadic reversals of letters, this quality of uncertainty was obvious in the movements of both hands. Concerning what seemed to be a mental reaction induced by the performance of simultaneous movements of bimanual writing, it was observed in 1 instance that after the subject had practiced two-handed writing for but a short time—not over five minutes—he was thrown thereby into such a state of confusion or indecision that for a few moments, much to his alarm, he was wholly unable to write his own name. Even after he had fully regained the use of his faculties his confidence in himself seemed shaken, as though the experience had temporarily unnerved him. The subject seemed to be an intelligent man. Nevertheless, because he was so upset by the test, the idea suggested itself that there might be a relationship of some sort between the state of disorientation so easily induced and the factor of mental balance or mental health.

#### QUALITATIVE PECULIARITIES OF SAMPLES OF BIMANUAL HANDWRITING

*Handwriting of Dextrals.*—Right Hand: (a) Size of Letters and Length of Text. If the three (1 unilateral and 2 bimanual) samples of the test word written with the right hand (fig. 2, RR and RL) are examined and compared with one another from above downward, it will be noted respecting each successive copy of the word: (1) that by degrees the forms of individual letters—particularly those of

the capitals—became taller and broader; (2) that in consequence of this increase in the size of the letters the word gradually stretched out more and more toward the right. In the case of the writer Helen, for example, it will be seen that the actual increase in length was from 19 to 30 mm., while in the case of the writer Victor, the increase in length was from 14 to 23 mm. Seventy-one per cent of the specimens of writing obtained from dextrals displayed this peculiarity.

(b) Configuration. If the same test words are examined with reference to the configuration of the letter forms, it will be seen that they gradually became more and more primitive in type. However, this involuntary process of simplification also revealed itself in two other graphic peculiarities. One of these peculiarities, noted particularly as regarded the formation of the capital letter "H," was that most writers showed a tendency to modify by degrees the decorative strokes applied to this letter and to outline the last sample of it simply with vertical lines (fig. 3).

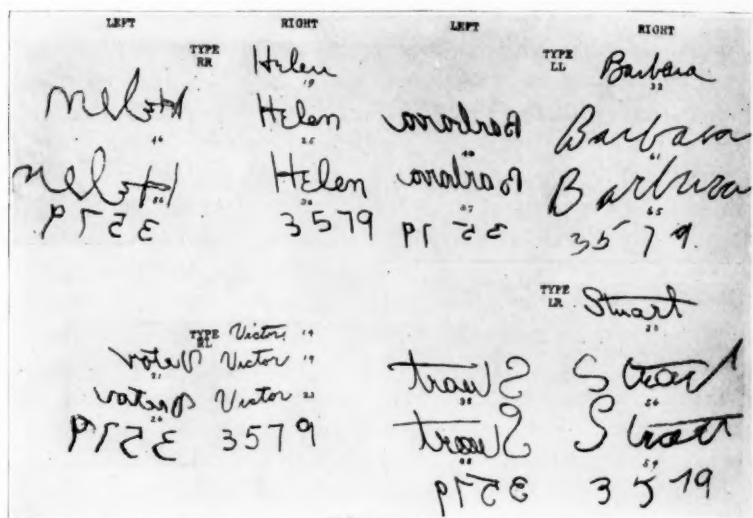


Fig. 2.—Samples of bimanual writings of dextrals and sinistrals. The figures show the lineage values. Note the suggestive traces of isomorphism both as to the lineage factor and as to the configuration factor.

The other peculiarity came to light in a series of collateral experiments carried out with subjects of the sort who embellish their writings by uptilting the cross-bar of the letter "t" so as to place it at various acute angles with the base line of the text. A number of persons given to this eccentricity were tested by being asked to write with the right and the left hand simultaneously a sentence in which the letter "t" occurred frequently. On examining the specimens obtained in this way, it was found in almost every instance that the bars of the letter "t" were level.

Left Hand: (a) Size of Letters and Length of Text. It was observed constantly that the movements of the left hand were more or less awkward and spastic and that the forms of the letters produced with this hand had a corresponding tendency to be large as well as irregular. Hence, although the samples of the test word written with this hand usually were much longer than the normal



far superior to those put forth with the right hand (fig. 2, LL and LR). This finding seemed especially remarkable because of the fact that all but 1 of the 29 persons tested wrote habitually with the right hand. Therefore, in regard to the question as to the relative importance of the two writing control centers, this evidence seemed to show that in sinistrals the right cerebral hemisphere (writing center), as compared with the opposite one, was naturally endowed with a superior faculty of line control. Since it did not seem at all likely that this apparent functional superiority on the part of the right cerebral hemisphere could be explained by the existence of a specially organized transmission network, or engram, whether established by kinesthetic memories or otherwise, it was surmised that the relative superiority noted in regard to one of the writing centers was probably determined by a chromosomal element.

Turning now to the main object in view, I shall introduce some data on lineage derived, respectively, from the specimens of bimanual writing of dextrals and sinistrals.

*Handwritings of Dextrals as Compared with Those of Sinistrals.*—Right and Left Types of Linage Superiority: Of the 100 specimens of script studied, 87 were contributed by dextrals and 13 by sinistrals. In accordance with the technic already described, each slip of paper exhibited five copies of the reactor's given name, and since the necessary measurements had been made, each copy of this test word was marked with a number that indicated its length in millimeters. As complete data on handedness and eyedness were available, it was a simple matter to segregate the slips into four groups representative of the principal dextral and sinistral types. When this had been done, the relative lineage values—right and left—of each group were studied and compared and then the paired (right and left) group values were compared with one another. The principal results may be stated briefly as follows: 1. In nearly all the samples of handwriting of the dextrals (RR and RL) the values referable to the left hand were larger than those referable to the right hand. 2. In the case of the sinistrals (LL and LR) precisely the opposite ratio was observed: It was found that the figures referable to the right were larger than those referable to the left hand. 3. In other words, the writings of dextrals and sinistrals were isomorphic in a linear sense.

Unfortunately, the lineage values obtained in this series of experiments were useless for statistical purposes as they were based on test words of which hardly any two were of the same length. Hence, as it was desired to study more accurately the relationship between these values and the factor of laterality, it became necessary to make a second series of tests. But before this work could be undertaken a suitable test word had to be selected. Finally, because it seemed to embody a number of desirable characteristics, the word "Halliard" was chosen. For the purpose in hand this word offered the following advantages: 1. It was of a suitable length—20 mm. in typed form. 2. Its capital, the letter "H," had several points to which decorative strokes were commonly applied. 3. Its two looped letters would serve well as models with which to study the relative angularity value. 4. Its general configuration was well adapted to reveal the slope of the text.

Various data obtained by means of this standard test word are described in the following section.

#### DATA OBTAINED WITH A STANDARD TEST WORD

*Graphic Sprawl and Handedness.*—(a) Percentage Relations: If the experimental results shown in table 1 are referred to, it will be noted: (1) that in 71.66 per cent of the specimens of double script obtained from the dextrals of the

type RR the specimens of writing produced with the left hand were longer than those produced with the preferred hand; (2) that in 90 per cent of the samples of bimanual script obtained from the sinistrals of the type LL the specimens of writing produced with the right hand were longer than those written with the left hand. These findings seemed to justify the conclusion that a more or less definite relationship existed between the two factors of handedness and contralateral lineage superiority.

(b) Average Sprawl Linage Values: The average values obtained with the writings of 84 dextrals (RR and RL) and 16 sinistrals (LL and LR) are shown

TABLE 1.—*Relation Between the Factors of Handedness and Graphic Sprawl; Data on the Linage Value of the Writings of 84 Dextrals and 16 Sinistrals Compared as to the Relative Lengths of the Writings Produced, Respectively, with the Right and Left Hands \**

Kinds of Subjects	Samples of Left-Hand Writing Longer Than Right		Samples of Left-Hand and Right-Hand Writing Equal		Samples of Right-Hand Writing Longer Than Left	
	Number of Samples	Percentage	Number of Samples	Percentage	Number of Samples	Percentage
Dextrals						
60 RR	43	71.66	1	1.66	16	26.66
24 RL	15	62.50	1	4.16	8	33.33
Sinistrals						
10 LL	1	10.00	0	0.00	9	90.00
6 LR	1	16.66	0	0.00	5	83.33

\* The standard test word was "Halliard."

TABLE 2.—*Right and Left Isomorphic Types of Bimanual Graphic Sprawl; Average Values Obtained for the Writings of 84 Dextrals and 16 Sinistrals \**

Kinds of Subjects	Mean Length of Sample of Left-Hand Writing, Mm.	Mean Length of Unimanual Control Word, Mm.	Mean Length of Sample of Right-Hand Writing, Mm.
Dextrals			
60 RR.....	45.0	36.5	40.4
24 RL.....	43.6	36.2	37.7
Sinistrals			
10 LL.....	32.9	29.3	43.4
6 LR.....	37.6	38.6	42.1

\* The standard test word was "Halliard."

in table 2. It will be seen that in the case of the dextral group RR the total value of the right sprawl amounted to 3.9 mm. while the total value of the left sprawl amounted to 8.5 mm. The corresponding figures for the sinistral group LL were 14.1 mm. for the right sprawl and 3.6 mm. for the left, respectively.

It seemed remarkable that these dextrals and sinistrals differed so greatly from one another as regarded the mean (unimanual) control values which were, respectively, 36.5 and 29.3 mm. This evidence seemed to show that, on the whole, the handwriting movements of the sinistrals were considerably less energetic than those of the dextrals.

*Simplification of the Capital Letter "H".*—Since much of the working material was obtained from students of art, many of whom formed this letter simply with three strokes of the pencil, it was possible to study only about 60 per cent of the

specimens with reference to the occurrence of a gradual change in the outline of the initial character. However, on scrutinizing such material as was available, it was found in practically every instance that the writer, whether a dextral or a sinistral, seemed involuntarily to have produced the letter "H" in such a way that it tended to become more and more primitive in form (fig. 3).

*Relative Values for Total Angularity.*—The figures for the total angularity in the writings of the 84 dextrals were 44 for the right hand and 189 for the left. The total values obtained for the 16 sinistrals were 18 for the right hand and 12 for the left.

*Involuntary Reversal of the Text Slope.*—In striking contrast to the well marked forward slope exhibited by nearly all the control samples of unimanual writing of the test word, it was remarkable that in many of the specimens written with the right and the left hand simultaneously the samples in the right-hand column exhibited varying degrees of back slant. It was conjectured that this shift to the left, as regarded the inclination of the text, might be due either (1) to the influence of a laterality factor or (2) to a postural factor that altered the relation between the transverse axis of the body and the line of writing. This

TABLE 3.—*Relative Incidence of Back-Slant Noted in Samples of Unimanual Handwritings Obtained by Means of a Standard Test Sentence from 710 Persons Representative of the Four Principal Dextral and Sinistral Types*

Kinds of Subjects	Number of Specimens	Text-Slope					
		Forward		Vertical or Partly Back-Slanted		Uniformly Back-Slanted	
		Number	Percentage	Number	Percentage	Number	Percentage
RR	504	465	92.2	37	7.3	2	0.3
RL	137	120	87.6	17	12.4	0	0.0
LL	38	29	76.3	5	13.1	4	10.5
LR	31	28	90.3	1	3.2	2	6.4
Totals	710	642	90.4	60	8.4	8	1.1

change in the inclination of the text was noted in 44 of the 84 samples obtained from dextrals and in 7 of the 16 obtained from sinistrals. As a rule the change in the slope was slight—usually less than 10 degrees; nevertheless, this tendency of the text to incline sinistral distinguished samples of bimanual from those of unilateral handwriting. It will be noted in regard to this point (table 3) that of 504 dextrals (RR) only 37, or 7.3 per cent, produced vertical or partly back-slanted writings.

#### SUMMARY

Experiments in bimanual handwriting carried out with a total number of 240 persons are described.

The results obtained appear to establish that any literate person of ordinary intelligence and will power can write with the right and the left hand simultaneously.

Specimens of bimanual handwriting so produced exhibit two characteristic structural peculiarities: (1) Successive copies of any given test word show a tendency to spread out irregularly (sprawl); (2) the forms of the individual letters tend not only to increase in size but also to become more and more primitive.



Data on lineage obtained by means of a standard test word from the writings of 84 dextrals and 16 sinistrals showed that for the majority (71.66 per cent) of the dextrals the lineage values were higher for samples of handwriting produced with the left hand than for those produced with the right, while for the majority (90 per cent) of the sinistrals lineage values were higher for samples produced with the right hand than for those produced with the left.

This evidence seemed to show that in a rough, linear sense there are right and left isomorphic types of bimanual graphic sprawl.

In a fair percentage of the writings studied this specific factor of contralateral lineage superiority was so clearly expressed that, in many instances, simply by noting the relative lengths of the two samples of script shown, it was possible to determine at a glance whether the reactor was right-handed or left-handed.

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## OBSERVATIONS ON EXPERIMENTAL NEUROSIS IN SHEEP

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The abnormal behavior of sheep which is about to be described appeared unexpectedly during experiments with conditioned reflexes which were planned to test the effect of thyroidectomy on the work of the nervous system.<sup>1</sup> The first animal was studied with sufficient care to convince us that its condition might be interpreted as an experimental neurosis such as Pavlov observed in dogs.<sup>2</sup> We reserved judgment, however, until a similar condition presented itself in a number of animals and it was discovered that there was evidence for interpreting it as a manifestation of an abnormal state of the nervous system experimentally produced.

Two considerations impel us to submit our material to clinicians: First, it seems remarkable that an enduring nervous disturbance can be produced in an animal as simple in its behavior pattern as the sheep by the innocuous procedure of conditioning.<sup>3</sup> Second, we had never observed such disturbances when sheep were caused to learn to escape from a maze, even though the problem was too difficult to be solved. The animal would placidly make mistakes in a complex maze day after day and each day would be willing to enter the labyrinth and try again. The conditioned reflex and maze habits could both be readily established, but only the training procedure of establishing a conditioned reflex led to a nervous breakdown. It should be of importance for the psychiatrist to know that it is possible to produce abnormalities of

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From the Department of Physiology, the Cornell University Medical College.

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1. (a) Liddell, H. S.: The Effect of Thyroidectomy on Some Unconditioned Responses of the Sheep and Goat, *Am. J. Physiol.* **75**:579 (Feb.) 1926. (b) Liddell, H. S., and Bayne, T. L.: The Development of "Experimental Neurasthenia" in the Sheep During the Formation of Difficult Conditioned Reflexes, *ibid.* **81**:494 (July) 1927.

2. Pavlov, I. P.: *Conditioned Reflexes*, New York, Oxford University Press, 1927.

3. It must be recognized that a conditioned reflex is only a name for a habit observed under experimentally refined conditions.

behavior by experimental means in animals in which the complexities of speech can play no part and that two simple procedures for establishing habits can be directly compared, one of which puts the nervous system under dangerous strain and the other does not.

#### METHOD

A brief description of our procedure for establishing conditioned motor reflexes will suffice for the understanding of the protocols to follow. The sheep to be conditioned was led to the laboratory. It ascended a platform and stood on a table where it might eat from a bucket of oats (fig. 1). Its freedom of movement was restricted by loops passing under the legs and attached to a beam overhead. With the incentive of food at the beginning and end of the experiment,

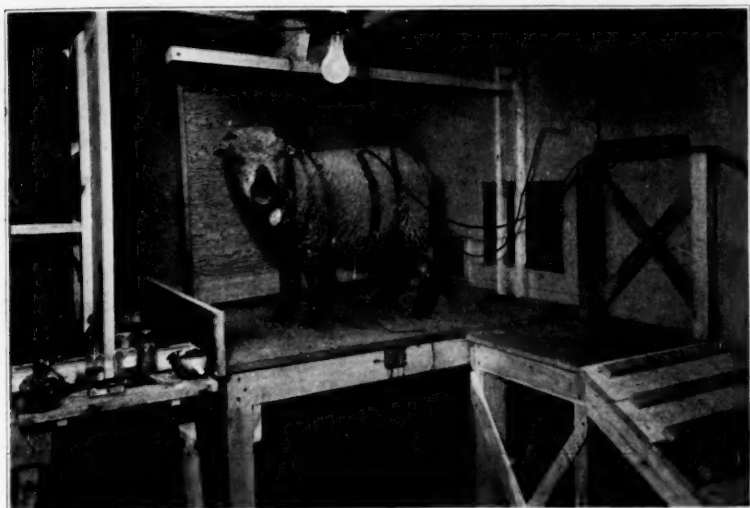


Fig. 1.—A view of the animal chamber for experiments on the motor conditioned reflex, showing attachment of the recording thread and shocking bracelet electrode to the left foreleg.

the sheep within a few days would run on leash to the laboratory from the barn, mount the table and remain quietly for as long as two hours. A leather bracelet wrapped with brass wires was attached to the shaved skin of the upper part of the foreleg. The wires were connected with an inductorium, the primary circuit of which was controlled by a pendulum switch. A brief tetanizing shock, not painful to the experimenter's touch (a Harvard inductorium with one dry cell and a coil separation of 4 cm. was the standard), evoked a brisk flexion of the sheep's foreleg, after which the animal immediately became quiet. This defensive reaction was the unconditioned reflex on the basis of which various conditioned motor reflexes were formed. If the shock was regularly preceded by some neutral stimulus such as the ticking of a metronome, soon the ticking of the metronome would elicit movements of the leg in anticipation of the shock. This anticipatory behavior was the newly formed habit or conditioned reflex. A string attached to

the foreleg actuated a recording lever which wrote on a kymograph in the adjoining room. A pneumograph strapped around the chest gave a tracing of the movements of respiration, which were recorded on the kymograph under the record of the movements of the leg. Signal magnets traced the beginning and the end of the conditioned stimulus (metronome, buzzer, tactile stimulus) and the moment at which the shock was given. Time was recorded in seconds. The reaction to shock or unconditioned reflex immediately followed the conditioned reflex. It is an important feature of the method that the shock was always administered after the signal had been given. To maintain a stable conditioned reflex the animal must not be deceived. The signal that a shock was coming was invariably followed by the shock. The animal quieted down within a few seconds after the shock had been administered.

In analyzing the experimental material it will later be necessary to discuss the broader implications of the conditioning method described here in order to discover why this seemingly simple procedure can strain an animal's nervous system to the breaking point. First, it is necessary to review in detail the histories which we propose to analyze. During the six years of investigation covered by this report, sixteen sheep were subjected to systematic training in the laboratory for research in the conditioned reflex. Of these, four suffered definite and long-enduring derangements of behavior.

#### OBSERVATIONS

**SHEEP 1.**—A castrated male sheep born in May 1922 had been employed in maze-learning experiments for almost four years and was distinguished by its well balanced behavior in this problem situation. In 1925 the animal was one of the first to be tested in our new laboratory for research on the conditioned reflex. A defensive conditioned motor reflex to tactile stimulation of a spot on the skin of the rump followed by electric shock to the foreleg was easily established, so that blunt tactile stimulation of the rump caused flexion of the left foreleg. During several days the same animal was subjected to testing of the threshold intensity of electric shock necessary to evoke the flexion of the forelimb. No sign of nervousness or stubbornness was observed at any time.

In order to test the effect of thyroidectomy on the formation of conditioned reflexes in sheep Bayne and one of us (H. S. L.)<sup>1a</sup> were engaged in the fall of 1926 in establishing the fundamental types of conditioned reflex described by Pavlov in normal sheep and in those from which the thyroid gland had been removed at the age of 3 weeks. The thyroidectomized sheep were dwarfed and lethargic and, in fact, strikingly resembled the human cretin.

In sheep 1 and in a cretin sheep we attempted to establish a delayed or retarded conditioned reflex to the sound of the metronome beating 60 times a minute. Following Pavlov's procedure, we began with a brief period of stimulation. The metronome ticking once a second for five seconds was followed by the shock, so that the shock and the sixth tick of the metronome coincided. Here the animals were trained to react by flexion of the foreleg not only to the sound of the metronome but also for a duration of five seconds. It was our aim through continued training to cause the animals to restrain the defensive movement of the leg until just before the shock. The rest intervals were varied from forty-five seconds to two minutes. Once a successful restraint of response was observed we planned to increase the duration of the ticking of the metronome before the shock to ten seconds, then to fifteen seconds and so on until the limit of retardation

or restraint of response had been reached. It might then be possible to observe some significant difference in conditioning between normal and thyroidectomized animals which we had not yet succeeded in noting. However, a scientific meeting was scheduled at which we hoped to make a report. For this reason the attempt was made to accelerate the training in order to get as many data as possible. The result of increasing the number of tests per day was that the behavior of sheep 1 suffered a sudden and radical change. From a quiet, well balanced animal it was transformed into a stubborn and highly nervous one.

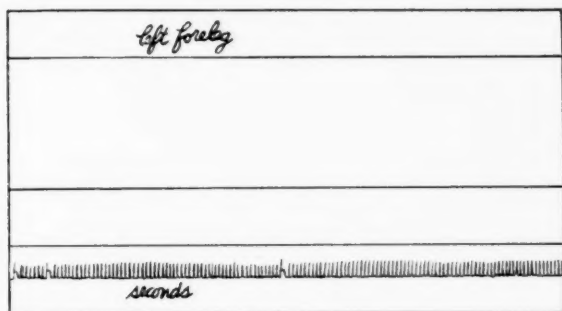


Fig. 2 (sheep 1).—A tracing showing complete absence of spontaneous movement of the leg before the neurosis developed. The myograph lever actuated by movement of the left foreleg traced the line at the top.

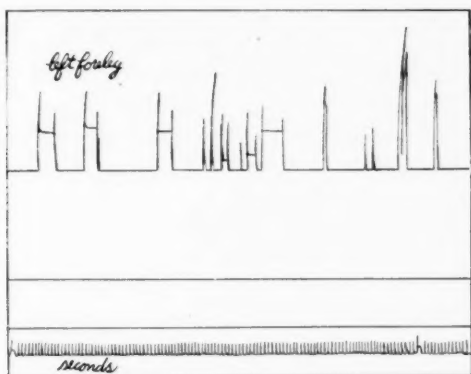


Fig. 3 (sheep 1).—A tracing showing characteristic nervous movements of the left foreleg during the interval between stimulations, which marked the onset of the first experimental neurosis.

At the beginning of the experiment on retardation normal and thyroidectomized animals were given 10 tests per day. Each animal was led to the laboratory where 10 presentations of the metronome followed by shock were given, after which it was released into the pasture. Not more than half an hour was needed for the daily test. However, to obtain results more rapidly we increased the number of trials to 15 per day for four days, then to 17 for a day and then to 20 per day. Up to this time, 98 combinations of metronome and shock had been employed.

On the second day that 20 tests were given sheep 1 exhibited the definite abnormalities of behavior shown in figures 4 and 6. Whereas it had formerly stood quietly on the table between tests (fig. 2) with but an occasional slight shift of posture it now exhibited persistent nervous movements, especially of the left foreleg (fig. 3), and whereas it had previously delayed the anticipatory flexion of the foreleg until just before the shock (fig. 4), it now reacted to each tick of the metronome with a vigorous and extensive lifting of the limb (fig. 5). A still more striking sign of altered behavior was its resistance to being led into the laboratory. Such behavior had never before been observed in this animal. Previously, when a chain was fastened about its neck while in the barn it would run willingly to the laboratory, pulling the experimenter along behind very much as an eager dog tugs at the leash. It now tried to run away from the laboratory and had to be dragged or pushed toward the experimental room and almost lifted

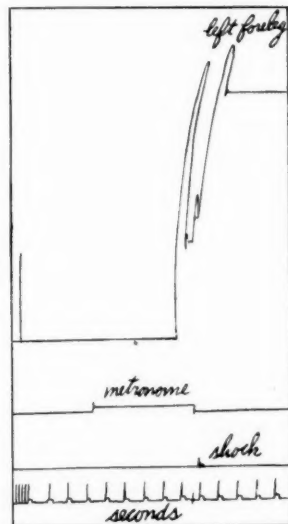


Fig. 4 (sheep 1).—A tracing showing a normal delayed reaction to ticking of the metronome at the rate of 60 beats per minute when the shock was applied to the left foreleg on the sixth tick of the metronome. In figures 4 to 12 the top line is a record of the movements of the foreleg. The next line shows the beginning and end of stimulation by the metronome; the third line, the shock, and the base-line, the time in seconds. In this tracing, in the second line the upstroke marks the start of the metronome, and in the third line the upstroke signals the application of the shock.

onto the table. However, once placed on the table it stood quietly, allowed the loops to be placed around its limbs and ate from the bucket of oats. As soon, however, as the experimenter left the room the sheep began its fidgeting, tentative movements of the left foreleg.

To quiet the animal, the number of tests was reduced, first to 10 and then to 5 per day, and the rest periods between them were lengthened to three or four minutes, but the effect of this procedure was to increase the animal's nervousness during the following three days. This was shown by the greater magnitude of spontaneous movements of the leg in figure 6 as compared with those in figure 3.



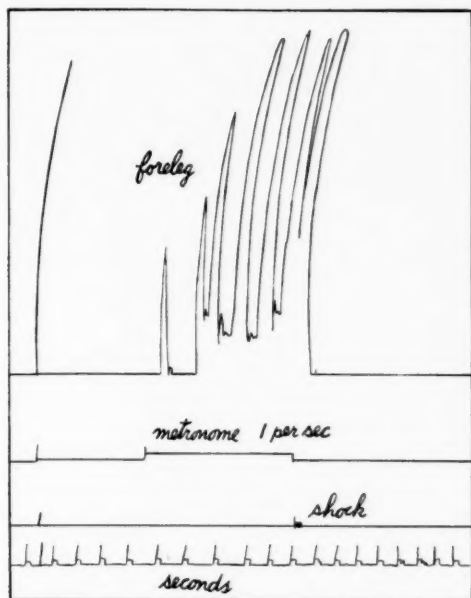


Fig. 5 (sheep 1).—A tracing showing the disappearance of inhibition or restraint which had been developed in the delayed reaction shown in figure 4. In the neurotic condition the animal responded by a vigorous flexion of the limb to each of the six beats of the metronome preceding the shock.

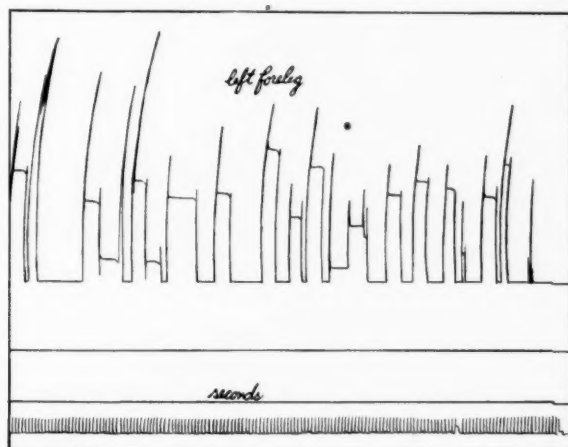


Fig. 6 (sheep 1).—A tracing showing the exaggeration of the nervous movements of the foreleg during the rest periods (shown in fig. 3) when training was continued after the neurosis developed.

It was then discovered that when the animal was brought to the laboratory and was placed on the table with oats to eat, if the experimenter left the room the nervous behavior was observed each day without metronome or shock, although the number of spontaneous movements of the leg decreased progressively during the period that the animal stood on the table. While the experimenter remained in the room with the animal it was always quiet, even when the harness was removed. The experimenter's presence in the room was, of course, associated with no testing.

Another remarkable fact was observed, namely, that the effect of the shock was to quiet rather than to excite the animal. This is well shown in figure 7. Spontaneous movements of the leg were observed at frequent intervals until the metronome sounded. A vigorous flexion of the left foreleg ensued, culminating in the reaction to the shock. The animal then became quiet and only after a period of one and a half minutes did the spontaneous movements of the leg begin again.

The thyroidectomized animal showed the usual signs of lack of thyroid in its lethargic and feeble neuromuscular reactions; nevertheless the delayed conditioned reflex to the ticking of the metronome was developed as readily as in the normal sheep 1. However, when the number of daily tests was increased its behavior altered, but in a manner opposite to that in sheep 1. During the second day of 20 tests, in 7 no response to the metronome was observed while in the other tests

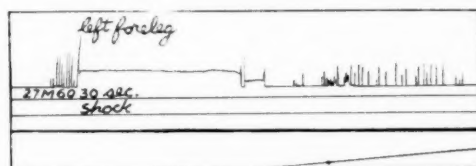


Fig. 7 (sheep 1).—A tracing showing the absence of movement in the foreleg, recorded on the top line, for a period of one and one-half minutes following the conditioned reflex shown at the left. At the right of the top line is seen the recurrence of the nervous movements of the leg preceding the next test.

there was an average delay of four seconds. The next day the delayed response became constant and remained so. No sign of nervousness or unwillingness to go to the laboratory could be noted. Finally, in attempting to discover the causation of the neurotic state in sheep 1 the number of daily tests in two other normal sheep was increased. In these animals, which had learned to react to a variable duration of the metronome at 120 beats per minute (simultaneous conditioned reflex) as the result of 152 tests, an increase in the number of combinations of the metronome and shock from 10 to 15, then to 17 and finally to 20 per day for three days led to no change in behavior either in the laboratory or outside.<sup>4</sup>

Following Pavlov's procedure in similar cases of nervous disturbances in the dog during the formation of difficult conditioned reflexes, three rest periods, of three, five and fourteen days, respectively, were allowed the "neurotic" sheep. After three days of rest the delayed reflex returned, but on the next day it disappeared again and the nervousness increased. At the end of the second rest period a distinct decrease in nervousness was noticed, and at the same time the delayed response began to appear oftener. At the end of the fourteen day vacation still greater recovery was observed, but a relapse soon followed.

4. These observations were made by T. L. Bayne.

Since it was no longer possible to continue the experiments with sheep 1 owing to its excitable and stubborn behavior we gave it a complete rest for one and one-half years. During this period it never entered the laboratory but spent its time with the other animals in the barn and pasture. At the end of this period it was brought to the laboratory, where it displayed its former type of reaction. Quiet between tests, it responded to the sound of the metronome by flexion of the foreleg, showing the perseveration of the conditioned reflex previously established. It could now be led to the laboratory without difficulty, and training was therefore resumed.

The particulars of this history which seem to be of special significance may be summarized as follows: The previous history of the animal indicates clearly that it was docile and well balanced, not only during its daily training in the maze but also in the early experiments with tactile conditioned reflexes of the simultaneous type (variable duration of conditioned stimulus), including the extinction of the tactile reflex in a long continued experiment in which tactile stimulation was repeated many times daily during a number of days without a single shock. It was subsequently discovered that this procedure put the sheep's nervous system under strain. Its refractory behavior developed when a reaction to a time interval (five seconds' duration of ticking of the metronome) was called for, and then only when the number of tests was increased from 10 to 20 daily. Two other sheep, one of which in subsequent work proved itself more excitable than sheep 1, did not, however, display abnormal excitability, even though tests of the conditioned reflexes to the metronome were also increased from 10 at each day's experiment to 20 per day. The essential difference between the reflex to the metronome in these two animals and that in sheep 1 was that the duration of the ticking of the metronome in tests of the former was varied at every presentation. It is also to be noted that the thyroidectomized animal exhibiting lethargy and muscular weakness characteristic of the athyroid condition, although trained in exactly the same manner as sheep 1 to give a delayed reaction of five seconds' duration to the metronome ticking at the rate of 20 beats per minute, showed a change in the opposite direction, i. e., toward complete restraint or inhibition of behavior, when the number of tests was increased from 10 to 20 per day. Finally, two features of the behavior of sheep 1 led us to suspect an experimental neurosis: first, the sudden appearance of resistance against being taken to the laboratory in spite of the fact that for several years it was a model of docility and, second, the fact that its nervousness in the laboratory, except when the experimenter was present in the room, increased from day to day even when the number of daily tests was progressively reduced. The animal was restored to normal after a protracted change of scene, viz., a vacation in the pasture.

When, after a year and a half, sheep 1 had recovered from its nervousness and unwillingness to go to the laboratory the former training procedure was begun again, but never more than 5 trials per day were given and usually only 2 or 3. Once again the animal stood quietly on the table, as in figure 2. The ticking of the metronome at the rate of 60 beats a minute was continued, as formerly, for five seconds before the shock. Soon a delayed reaction was developed, and then the duration of the ticking of the metronome was lengthened to eleven seconds. When a proper delayed response to this duration of the stimulus was

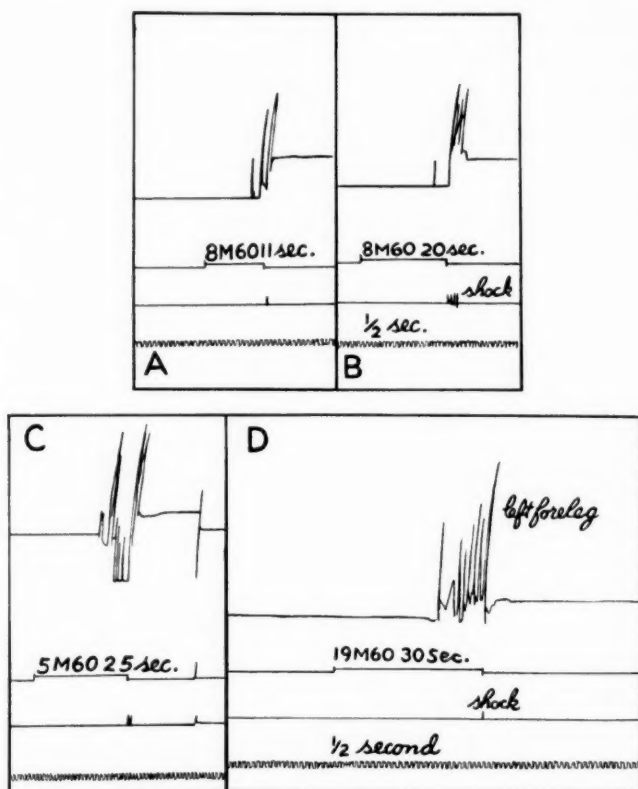


Fig. 8 (sheep 1).—Tracings showing stages in the establishment of a delayed conditioned reflex to the ticking of the metronome once a second for thirty seconds followed by a shock to the left foreleg. *A* indicates the delayed reflex to stimulation of eleven seconds, *B* to stimulation of twenty seconds, *C* to stimulation of twenty five seconds, and *D* to stimulation of thirty seconds. In *A*, the legend 8M60 11 sec means that on the eighth test the metronome ticking at the rate of 60 beats per minute ticked for eleven seconds before the shock was applied. A similar interpretation is applicable to legends on succeeding tracings.

secured the period of the ticking at 60 beats a minute was increased to fifteen seconds. Each increase of five seconds in the duration of the conditioned stimulus was effected only after an adequate delayed response to the shorter period of

stimulation had been secured, i.e., only after the animal had learned to restrain the movement of its leg until just before the shock was due. In other words, we attempted to lengthen progressively the latent period of the response to the metronome. In these experiments the interval between tests varied from one to ten minutes. Figure 8 shows sample tracings of the delayed reactions obtained in this series of tests.

Finally, the ticking of the metronome at 60 beats per minute continued for thirty seconds before the shock was given, and good delayed responses were secured (fig. 9).

On the tenth day of training for the thirty second delayed reflex to the ticking of the metronome at the rate of 60 beats per minute definite neurotic signs appeared in the form of nervous movements of the leg during the rest intervals, but the response to the metronome on this occasion still showed a delay or latent period of fifteen seconds. On the next day, at the first test with shock after thirty seconds all trace of delay vanished and the animal gave a violent motor reaction to each tick of the metronome (fig. 10). The sudden disappearance of the restraint which had been built up through 28 previous presentations of the

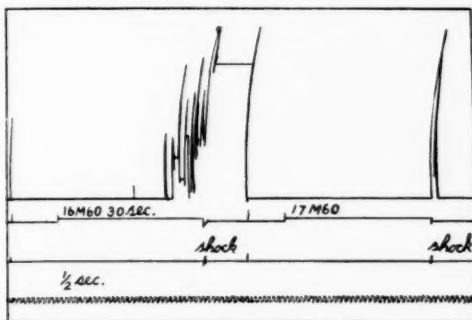


Fig. 9 (sheep 1).—At the left is shown the delayed reaction of the foreleg to the ticking of the metronome for thirty seconds before the shock was applied. On the next test, shown at the right, the premonitory negative phase of the neurosis is indicated by the failure of the animal to react to the sound of the metronome. The movement of the leg was in response to the shock. The animal restrained its response to the metronome stimulus until too late.

ticking of the metronome for thirty seconds was accompanied by an abrupt increase of the movements of the leg during the rest interval which had appeared on the previous day (fig. 11). Once more the sheep resisted being taken to the laboratory. The former abnormal condition was fully reinstated.

One interesting feature of the recurrence of the neurotic behavior in this animal which we particularly noted was a negative or inhibitory phase preceding the excitatory outburst of the fully established experimental neurosis. This negative phase is illustrated in figure 9. Here, as in a number of other tests given just before the delay vanished, the sheep waited too long and received the shock before any anticipatory movement of the leg was executed.

The central fact which appears here is the recrudescence of the former nervous condition after a period of normal behavior in the laboratory (from Aug. 22 to Sept. 29, 1927). The actual details, such as

unwillingness to go to the experimental room, nervous tentative movements of the foreleg in the interval between stimulations and even the period of quiet following the shock, were the same in the two instances. Profiting by the experience gained in the first case, protracted daily testing was avoided, and the number of tests given each day was usually 2 or 3 and never more than 5.

The immediate cause of the first and second periods of nervous derangement in this sheep cannot be certainly determined. It seems,

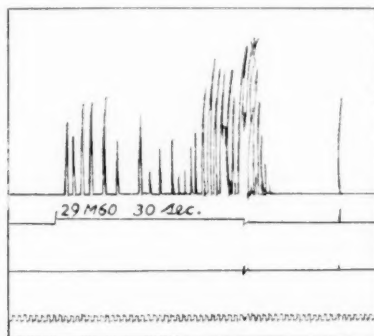


Fig. 10 (sheep 1).—A tracing showing that the restraint of inhibition of the response to the ticking of the metronome once a second for thirty seconds before the shock was completely abolished. The animal responded by a vigorous flexion of the foreleg to each tick of the metronome. Compare this tracing with that in figure 5.

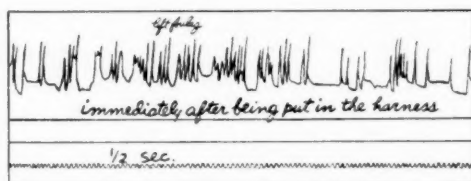


Fig. 11 (sheep 1).—A tracing showing the nervous movements of the leg during a rest period between conditioned reflexes when, after a vacation of a year and a half, the animal exhibited a recurrence of the neurotic state.

however, as if the difficulty leading to the first disturbance was the rapid and frequent transition from inhibition to excitation or from restraint to action. A restraint of five seconds while the metronome ticked was required for adequate adjustment since the shock was always applied at the sixth tick of the metronome beating once a second. The tests were probably spaced too close together in time and too many of them were given in immediate succession. It may be that the sheep was placed in the same predicament in which a nervous child is involved



when it is required to obey too many commands, one after another, especially if they seem to the child to be contradictory.

The recurrence of the neurotic behavior in this animal was probably the result of a situation in which too much restraint was required. Profiting by the observations of the first disturbance the number of daily tests was reduced to an average of 3, and the rest intervals were lengthened to an average of five minutes. At this leisurely pace it proved possible to prolong the conditioned stimulus to the ticking of the metronome for thirty seconds before the shock, and a delayed response with a latent period of over twenty seconds was established, but the reaction did not remain stable. The restraint or inhibition of the movement of the leg first became exaggerated and then disappeared altogether with a full reinstatement of the former abnormal behavior.

According to Pavlov, the intensity of cerebral inhibition increases as the latent period of the delayed conditioned reflex is lengthened. In dogs, however, a delayed conditioned salivary response to a signal of three minutes' duration is not unusual. At the termination of our experiments the beating of the metronome at the rate of 60 per minute was continued for thirty seconds before the shock. This thirty second delay before the shock may have been close to the limit of the capacity of this particular sheep's nervous system for developing restraint or inhibition. We believe that this was the case.

**SHEEP 2.**—A female, 1 year old, without previous training either in the maze or in the laboratory, was selected for a conditioning experiment. The object was to determine the limit of discrimination of rates of ticking of the metronome. The ticking of the metronome at the rate of 120 to the minute was always followed by a shock. The duration of the stimulus by the metronome varied from three to ten seconds to avoid conditioning to time. The rest periods varied between one and four minutes. A slower rate was never to be followed by a shock, and the aim was to secure a negative reaction to ticking at a rate of 50 beats per minute and then to increase the rate to 60 without shock, then to 72 and so on until the limit of discrimination was reached.

According to Pavlov two procedures are practicable for securing a discrimination between two stimuli in experiments on the conditioned reflex. After a positive conditioned reflex has been established to one of the stimuli, the other may become negative or inhibitory (or differentiated) by nonreinforcement, i.e., by withholding food in the case of alimentary salivary conditioned reflexes or by withholding the electric shock in defensive motor conditioned reflexes. The stimulus which is to become negative can be presented occasionally without reinforcement, preceded and followed by positive conditioned stimuli reinforced by food or shock as the case may be. This is the method of contrast. The second procedure for establishing a negative or inhibitory conditioned reflex is to present the stimulus chosen to become negative time after time without reinforcement until the positive response (flow of saliva or a defensive motor reaction) completely disappears. This is the method of extinction and was the one selected to enable us to establish a discrimination in sheep 2 between ticking at 120 beats per minute and slower rates.

After 120 combinations of ticking of the metronome at 120 beats per minute and shock, an extremely stable positive conditioned reflex had been formed. Now the procedure for extinction just described was employed. The ticking of the metronome, at a rate of 50 to the minute, was repeated without shock. Each presentation, ten seconds in duration, was followed by a pause of one minute. The animal had been trained to respond to the ticking at a rate of 120 beats in anticipation of a shock, but every positive conditioned reflex is at first generalized. The animal will react to other stimuli which resemble the training stimulus. So sheep 2, because of the generalization of the reflex to the ticking of the metronome, gave a vigorous defensive reaction to the slow rate of the metronome at its first presentation. In the normal course of events the positive response grows weaker if the conditioned stimulus is to be differentiated (rendered negative or inhibitory) is repeatedly given without reinforcement, and eventually it fails to appear. This sheep, however, continued to give defensive reactions to ticking at the rate of 50 beats per minute during the first and the second day, although no shocks had been given from the beginning of the experiment on extinction. The positive conditioned reflex grew weaker but did not disappear. At the end of a series of 42 presentations of ticking at 50 beats per minute without shock, distributed over two days, the now well recognized neurotic symptoms appeared.

The first sign of atypical behavior was observed outside the laboratory. It was noted that the animal became difficult to handle. At every attempt on the part of the experimenter to catch it when it was in the barn or the pasture with the rest of the flock, it ran away and resisted every attempt to put the leash about its neck. When cornered it would almost always suddenly crouch and begin to tremble violently. Instead of trotting quietly to the laboratory as usual, it had to be dragged there and lifted on the table, where again it would crouch. All attempts to calm it were unsuccessful. When the restraining straps were applied it would suspend itself by them, with the limbs flexed beneath the body.

After the long series of negative stimuli at 50 beats per minute we now decided to contrast the response to ticking at a rate of 50 with that to ticking at a rate of 120, presenting the two stimuli alternately. During the next few days the animal became increasingly more nervous and excited. On the presentation of either the positive or the negative conditioned stimulus the most vigorous and violent defensive reactions ever observed in our experience were noted. And the reaction to the negative was sometimes more vigorous than that to the positive stimulus followed by the shock. Not only were the reactions greatly augmented but they differed qualitatively from the usual calm and precise flexion of a single limb (the one to which the shock was always applied). The animal struggled to get down from the table, and of course this involved movement of all four limbs and the head. At this stage we noticed the appearance of spontaneous defensive movements of the limb receiving the stimulus in all the rest periods between stimulations, which was in marked contrast to the previous quietness in these intervals.

Since further presentation of the differential stimuli seemed only to aggravate the condition we were forced to abandon the experiments on this animal.

The positive reaction to the negative stimulus should be considered in relation to the disturbance in sheep 1 in which all trace of delayed response vanished (fig. 11). In terms of Pavlov's theory of cerebral function, the long latent period of the delayed conditioned reflex and the absence of anticipatory response to the negative conditioned stimulus are both due to inhibition developed as the result of training. In the nervous disturbances described, the inhibition or power of restraint had apparently vanished.

The animal was given a complete rest for one year, and when tested again all signs of hyperexcitability and nervousness had disappeared. However, when the reaction to ticking at a rate of 120 was again contrasted with that to ticking at a rate of 50 over a period of a few weeks, the signs of the disturbance reappeared. No evidence of a complete and lasting recovery has been observed in the course of five years.

A feature of special interest in this case is the readiness with which the animal succumbed to a situation which we judge to be of very slight difficulty, since on a number of previous occasions discriminations had been established in sheep by this same method of excitation. The

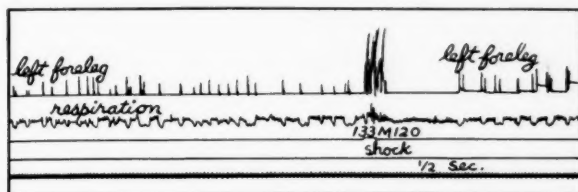


Fig. 12 (sheep 2).—A tracing indicating the neurotic condition. The respiratory movements in this and the following figures are indicated in the second line from the top. Note the vigorous defensive movements of the test leg elicited by the ticking of the metronome at 120 beats per minute followed by the shock. Note also the intermittent spontaneous defensive movement of the leg preceding the stimulation and following it after a brief quiet period. Respiration was irregular.

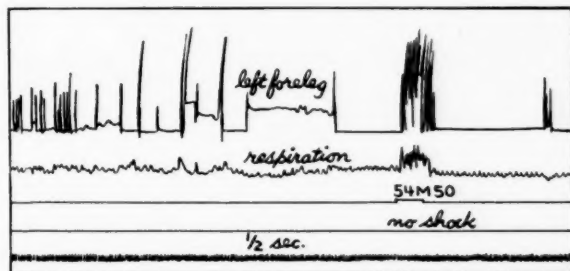


Fig. 13 (sheep 2).—A tracing indicating the neurotic condition. The defensive response to the fifty-fourth presentation of the negative conditioned stimulus (ticking of the metronome at a rate of 50 per minute, not followed by shock) was even more vigorous than that to the positive conditioned stimulus (ticking of the metronome at a rate of 120 per minute followed by shock). Compare this tracing with those in figures 5 and 10.

long persistence of the abnormal nervous state should also be considered in relation to the preceding observations. Figures 12, 13 and 14 illustrate the results obtained on this sheep. In this animal the most severe and enduring nervous disturbance observed was occasioned by the simple procedure of repeatedly sounding the metronome at the rate of 50 beats per minute without shock after the animal had been trained

to expect a shock to follow the ticking of the metronome at 120 beats per minute. It seems certain from these observations that the discomfort or annoyance of the shock could not have been responsible for the onset of the profound disturbance in behavior just described.

**SHEEP 3.**—A castrated male was 2 years of age at the time of these observations. The problem was to establish the limit of discrimination of the rate of ticking of the metronome, as for the previous animal. One hundred and twenty beats a minute was the positive rate, always followed by an electric shock. The duration of the beating varied as did the rest periods between stimulations.

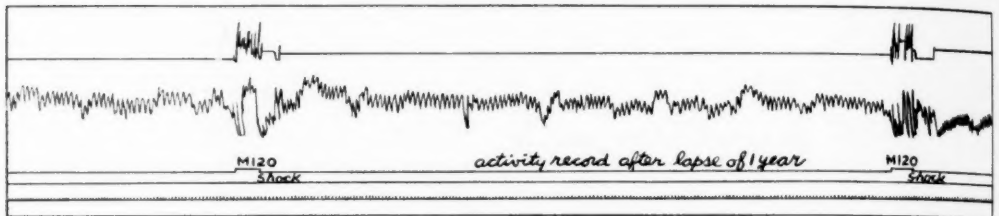


Fig. 14 (sheep 2).—A tracing indicating the effect of a rest of one year on the neurotic condition. The animal remained quiet in the interval between the stimulations by the metronome (ticking at a rate of 120 per minute followed by shock). The defensive reactions to stimulation and the respiration were normal.

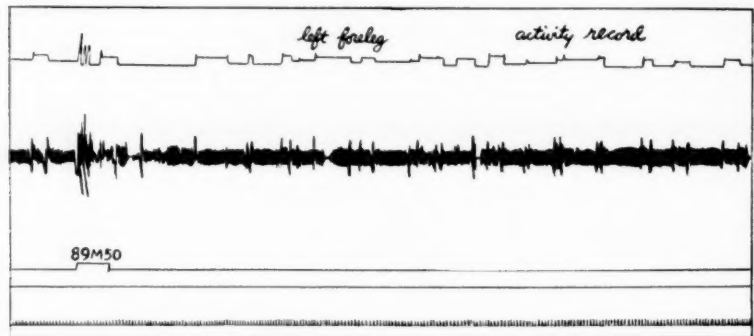


Fig. 15 (sheep 3).—A tracing made when the neurotic condition was at its height. The negative conditioned stimulus (ticking of the metronome at a rate of 50 per minute not followed by shock) evoked a defensive reaction, and spontaneous movements of the test leg occurred during the rest period between stimulations. Respiration was hastened and irregular.

Sheep 3 must be classed with sheep 1 as an unusually well balanced animal. It entered the laboratory willingly and responded with machine-like precision to the conditioned stimuli. Discrimination of the various rates was easily achieved, and the positive and negative reactions were unequivocal. Finally the animal was able to differentiate ticking at a rate of 120 from ticking at a rate of 92 beats per minute, giving a vigorous defense reaction to the former but not to the latter. However, when this level of proficiency had been reached and the animal

had demonstrated its inability to discriminate 120 beats per minute from 100 beats per minute (this is not far below the limit for discrimination by the adult human subject) it was subjected to a series of special tests of about two hours' duration each day. At each of these tests the whole gamut of rates was presented in turn; for example, stimulus at the rate of 120 beats per minute, shock, stimulus at 50 beats, no shock, stimulus at 120 beats, shock, stimulus at 60 beats, no shock, stimulus at 120 beats, shock, stimulus at 72 beats, no shock, stimulus at 120 beats, shock, stimulus at 84 beats, no shock, stimulus at 120 beats, shock, stimulus at 92 beats, no shock. The next day the stimuli were presented in the reverse order.

This procedure was continued during the next few weeks, and at the end of this time the animal's behavior began to undergo a curious change. All the conditioned defensive reactions both to the ticking at a rate of 120 beats plus shock and to ticking at a rate of 100 beats without shock (the rate the animal could not discriminate) became greatly weakened and completely disappeared in a great many cases. The rate of 120 beats per minute was tried alone for several

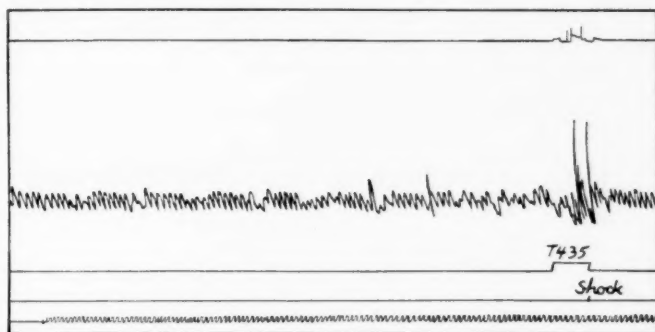


Fig. 16 (sheep 4).—A tracing showing the behavior in the early training period prior to the appearance of the neurotic condition. Small, precise defensive movements of the leg were elicited by the pure tone of 435 double vibrations (T435) followed by shock. The animal was quiet in the period just preceding the stimulation.

days, and the reflex was evoked only after it had been preceded by a number of exceedingly short periods of stimulation, each followed by the shock. This condition lasted for about one month and was followed by one characterized by excitement. The reaction to ticking at a rate of 120 beats per minute now reappeared, but in an exaggerated form. The response was extremely violent and was evoked not only by the positive stimulus ticking at a rate of 120 beats per minute but by ticking at rates of 100, 92, 84, 72, 60 and even by 50. The animal could no longer make even the easiest discrimination. At this stage all the symptoms of neurotic behavior described in the previous histories appeared (fig. 15).

Three years have now elapsed without recovery. The cause of the breakdown in this sheep seems to be twofold. First, the animal was pushed to the limit of its ability to make an auditory discrimination and, second, the duration of the special tests under what must have been great nervous strain was excessive. In this respect the history resembles that of sheep 1, in which the number of daily tests was increased beyond endurance. In the case of each of these sheep the

disturbance presented two fairly distinct phases, i.e., a phase of inhibition and then one of excitation.

**SHEEP 4.**—A castrated male, 1 year of age, was trained to react to positive and negative conditioned stimuli presented at intervals of exactly seven minutes. The procedure was as follows: A pure tone of 435 double vibrations was sounded

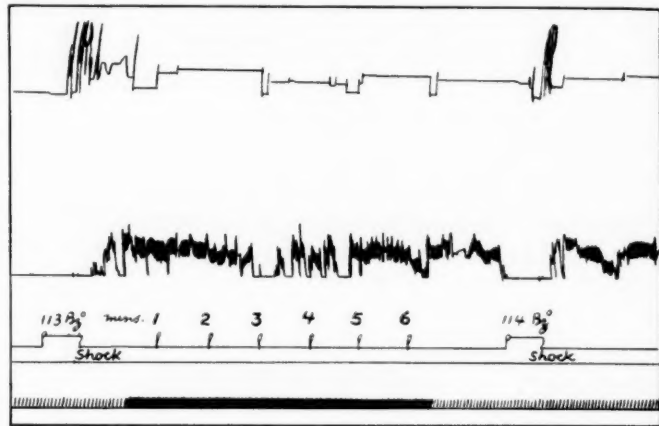


Fig. 17 (sheep 4).—A tracing indicating the fully developed neurosis. Note the magnitude and vigor of the defensive reflexes to the buzzer (*Bz*) and shock, the spontaneous movements of the leg in the rest period between the two stimuli and the greatly hastened and irregular respiration.

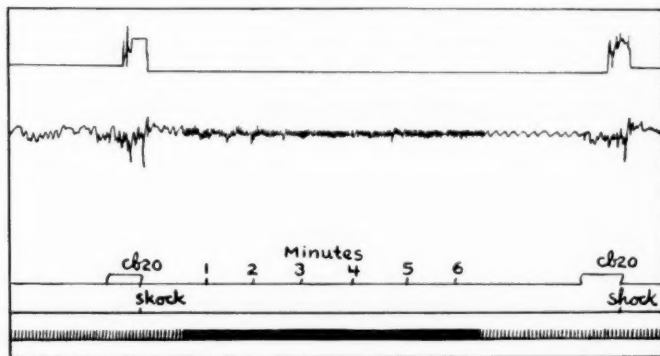


Fig. 18.—The defensive reactions of a normal sheep (sheep 11). The defensive reactions to the buzzer (*Bz*) and shock were normal. The animal stood quietly during the rest period between the two tests. Respiration was normal. Contrast the behavior picture in this animal with that in sheep 4 (fig. 17).

for ten seconds and was immediately followed by an electric shock to the left foreleg. Exactly seven minutes were allowed to elapse before another tone, one of 900 double vibrations, not followed by shock, was presented for 10 seconds. The formula for each day's training was: tone of 435 vibrations, shock, seven



minutes' rest, tone of 900 vibrations, no shock, seven minutes' rest, tone of 435 vibrations, shock, seven minutes' rest, tone of 900 vibrations, no shock.

The object of this experiment was to establish, if possible to do so in the sheep, a rhythmic alternation in time between the process of excitation and that of inhibition—in other words, to establish a situation in which the animal is trained to the following definite temporal sequence: action, restraint, action, restraint.

At the end of one month, during which the schedule was repeated daily, the negative stimulus, a tone of 900 vibrations, still evoked as marked a defensive reaction as the positive stimulus, a tone of 435 vibrations, which was followed by shock. It was apparent that the animal could not discriminate between the two tones. At this point the sheep became restless and unmanageable, and almost immediately thereafter neurotic symptoms made their appearance. The spontaneous movements of the test limb appearing during the seven minute interval were always precise, slight and hesitant, and at times each movement was preceded by a very slight trembling of the limb. This was the only nervous animal in which we observed such a premonitory tremor.

The animal was later trained to react to the buzzer and shock at seven minute intervals. The neurosis remained unchanged. The nervousness has lasted for two years. It is interesting to note that in another castrated male of the same age the same routine for establishment of a conditioned reflex resulted in no disturbance. Figures 17 and 18 contrast the neurotic behavior of sheep 4 with the normal behavior of the other sheep in the schedule just described. Figures 16 and 17 illustrate the development of the neurosis in sheep 4.

It is apparent that adherence to a fixed temporal pattern of stimulation in which positive conditioned stimuli alternate with negative stimuli placed this animal's nervous system under a great strain.

#### COMMENT

In each of the animals whose history has been described an end-point was reached in the process of establishing motor habits by forming a conditioned reflex. A docile sheep was suddenly transformed into a stubborn, highly nervous one. Regardless of the special conditioned reflex which was being established at the time or of the previous training of the animal, when this so-called end-point was arrived at all the sheep exhibited virtually identical behavior.

The abnormal condition described in our four animals, which we have identified with Pavlov's experimental neurosis, can be characterized as follows:

1. The animal, previously willing to go to the laboratory, now vigorously resisted.
2. When placed in the harness it remained quietly on the table until the experimenter left the room to begin the tests. At this point the sheep showed a type of activity never observed in a normal animal. It began repeatedly to lift the left foreleg (which had received the electric shocks during the conditioning experiments). These movements were unlike those evoked either by the conditioned signal or by the shock itself. Perhaps the best description is to liken the movements

to the fidgeting of a child or of a nervous adult when he is required to sit quietly. Whereas the animal had previously stood on the table for long periods without movement (fig. 2), it now lifted the left foreleg repeatedly in a nervous, tentative fashion. These movements usually increased in frequency and amplitude as the time for the next conditioned reflex approached.

3. In our experiments the positive conditioned stimulus (signal for the shock) was always followed by a shock to the foreleg. This stimulus invariably elicited a brisk flexion of the limb, after which the animal at once became quiet. The neurotic sheep likewise became quiet on the application of the shock, no matter how nervous it might have been before this stimulation. The period of quiet usually lasted about a minute and then the nervous movements began again. The shock appeared to relieve the tension which had been rising since the last test.

4. When the end-point separating normal from neurotic behavior was passed, the animal's nervousness was always aggravated by the laboratory environment. No matter how drastically the daily training schedule was reduced, the nervous movement of the leg and general restlessness continued to increase (figs. 3 and 6). Touching the limbs in turn would evoke a sudden twitchlike response from each, and in some cases the effect crossed the cord so that touching the left foreleg lightly with the finger elicited a brisk flexion of the right foreleg.

From time to time as the animal stood on the table it would give a violent start resembling the response of a normal sheep to a sudden loud noise. Another unusual feature of the aggravated neurosis was the response of sheep 4 to the buzzer. The usual reaction of the normal animal to the beginning of a positive conditioned stimulus is a sudden raising of the head (orienting reaction). This is followed after a latent period by flexion movements of the foreleg. However, in this case the buzzer elicited a violent flexion of the left foreleg; then after a latent period a series of movements of the foreleg were observed, beginning with a small flexion and building up to responses of larger magnitude as the shock approached. In other words, a violent defensive movement of the foreleg seemed to replace the usual orienting reaction of the head.

5. The only way to alleviate the condition so far discovered is to keep the animal away from the laboratory. When sheep 1 was given a vacation of a year and a half the abnormal behavior was found to have completely disappeared.

Is it possible to furnish a reasonable hypothesis to account for these instances of abnormal behavior in sheep? It is certainly important to attempt to do so, particularly since a hypothesis really means a program for future experimental investigation. Our purpose will be fulfilled if we confine ourselves to the study of animal behavior,

leaving to psychiatrists the attempt to relate these observations to similar disorders of human behavior.

It may be said at once that we have arrived at a general point of view rather than at a specific hypothesis in seeking to explain the instances of abnormal behavior just described. We believe, however, that this point of view will give a useful orientation to investigators wishing to place the problems of psychiatry on a simple experimental basis. The physiologist has laid a secure foundation for cardiology in experimentation on animals. Cannot the same thing be accomplished for psychiatry?

The first steps toward this goal were taken by Pavlov, and all future work in this direction must be influenced by his classic description of the experimental neurosis in dogs. It was his description which led us to recognize clearly and to attempt to analyze the similar disturbances in the behavior of our sheep. Needless to say, we persistently attempted to explain our results in terms of his theory. But this led to difficulties, the resolution of which brought us to our present point of view and program of investigation.

Pavlov's theory of neural action can be briefly stated as follows: The state of the higher nerve centers depends on a system of cerebral bookkeeping in which the total amount of excitation in the various centers at any moment is balanced against the total amount of inhibition in other centers. Further, the brain can supply a limited amount of inhibition and of excitation. When too much of the one or of the other process is required to adjust the organism to a difficult situation, a bankruptcy occurs either of excitation or of inhibition. If the inhibitory account is overdrawn the balance swings toward an excess of excitation (the cell mechanism for producing inhibition being weakened), and the excitatory type of neurosis results. When the excitatory account is overdrawn the balance swings in the other direction, and the inhibitory or somnolent type of neurosis is apparent. A "cure" is effected only by a restoration of the damaged excitatory or inhibitory mechanism of the cerebral cells. This fascinating theory presents the conception of a double capacity factor in neural adjustment and attempts to embody the notion in physiologic terminology. Behavior, as viewed by Pavlov, is a bipolar or stop-go process. Action is occasioned by cerebral excitation and restraint from action by cerebral inhibition. But the cerebral nerve cells have only a certain capacity for generating inhibition or excitation. The nervous system of some normal persons shows deficiency in inhibition, and that of others a deficiency in excitation. On the relation between these two capacity factors temperament depends.

One fact puzzled us a great deal. Why was it that during a period of five years more than fifty sheep of all ages were tested for their ability to learn to escape from mazes and many were unable to learn

and yet in no instance was any nervous disturbance produced? One of the animals persevered unsuccessfully in attempting to learn a difficult maze problem for three years but was always willing to enter the maze at each test. Furthermore, sheep 1, with four years of experience in maze-learning, subsequently suffered two severe neuroses during the establishment of a conditioned reflex. Again, why was it that no investigator other than Pavlov had reported nervous disturbances in dogs? The animals have certainly been extensively employed in learning experiments.

Reflection on the problem just mentioned convinced us that Pavlov's theory does not really illuminate the experimental cause of the neurosis either in the dog or in the sheep. The secret of origin of the disordered behavior in both species is to be found, we believe, in an analysis of the method of establishing the conditioned reflex. It is necessary to determine in what fundamental respect it differs from the methods commonly employed by comparative psychologists in the study of learning. It seems to us that the essential feature of the technic of establishing a conditioned reflex is that it suppresses spontaneous activity through habituation. The animal is trained to stand quietly on the table and responds only to a carefully controlled change of environment (stimulus) initiated by the experimenter. Following the activity in response to the conditioned or unconditioned stimulus it again relapses into a state of alert quiet. This behavior is to be contrasted with what is observed in the maze, discrimination box, multiple choice apparatus and other arrangements for studying the formation of habits in which the animal is given freedom of movement. In these situations random exploration enables it finally to receive a reward or avoid punishment. But freedom of locomotion also enables an animal to run away from a problem rather than to solve it. For example, a maze problem which no sheep ever successfully mastered was as follows: In a labyrinth of three alleys, either outer alley could be made a culdesac. The sheep, released from the starting compartment, was able to rejoin the flock and secure food by going down the central alley and turning to the right on the first trial. The turn to the left led into the blind alley. On the next test the sheep turned to the left in order to avoid the culdesac, the position of which was reversed at every trial. The problem consisted in learning to turn right, then left, then right and finally left in four successive trials. What several of the sheep actually did was to turn always to the right. By this simple procedure the animals went by the most direct path at the first and third tests and by a roundabout path (into and out of the culdesac) on the second and fourth tests. This behavior, commonly called a position habit, became thoroughly stable and enabled the sheep to avoid a difficult adjustment through extra locomotion.

We were able later to contrast this evasion of the alternating maze problem with the sheep's behavior in attempting to effect an adjustment to an alternating pair of conditioned stimuli. An animal had previously formed a positive conditioned reflex to the sound of a buzzer followed by a shock. A bell was then sounded but no shock was given, and the sheep soon came to associate the bell with absence of shock (negative conditioned reflex). The discrimination of the buzzer from the bell was achieved without difficulty. Restlessness in the laboratory was never observed. The sheep regularly responded to the buzzer with vigorous flexions of the left foreleg but stood quietly when the bell was rung. A year later the same animal was subjected to a new schedule. The buzzer and bell were now presented each day according to the following definite pattern: buzzer (ten seconds), shock, 3 minute rest, bell (ten seconds), no shock, three minute rest, buzzer (10 seconds), shock, three minute rest, bell (ten seconds), no shock. The animal was then released. Within two days the sheep began to show the premonitory signs of a neurosis, i. e., resistance against being led to the laboratory and restlessness when on the table. In this case, however, training was discontinued before the spontaneous movements of the leg appeared and while a negative reaction to the bell was still observed. It is almost certain that had we persevered a few more days according to the schedule of alternating positive and negative conditioned stimuli we should have been able to report another case of experimental neurosis. In sheep 4, which was trained to respond to alternating signals from the start, a neurosis soon developed.

Even when sheep or goats learned for the first time to escape from a maze of three alleys, one of which was a culdesac, evasive behavior was observed. Particularly in younger animals, exploration of the maze was interrupted from time to time while they nibbled at tufts of grass or nosed at dead leaves. It became necessary to cover the ground with cinders and to weed and clean the maze regularly in order to thwart this form of procrastination.

It is reasonable to imagine that locomotion, or more generally spontaneous neuromuscular activity, provides an escape from situations to which adequate adjustment is difficult. A difficult problem faced implies increased nervous tension (increased cerebral excitation or inhibition, according to Pavlov's theory), but the neuromuscular mechanism provides an outlet through which this tension may be lowered by the performance of random muscular movements. According to this point of view, the most striking feature of the conditioned reflex method is that through training spontaneous activity is suppressed, with the consequence that the animal can be forced to attempt difficult adjustments such as reacting to stimuli presented according to a rigid schedule and discriminating between closely similar rates of ticking of a metronome. We believe that when a serious problem of adaptation or adjustment is

presented to the animal in the laboratory nervous tension is generated because evasive activity has been repressed through training. If the difficulty is beyond the animal's powers of successful response a nervous breakdown ensues because the demands of the situation exceed the capacity of the nervous system for sustaining the required tension. As a consequence, when the neurosis develops the neuromuscular outlet which has been closed through previous training in the laboratory now opens because of actual damage to the nervous system to prevent any further rise of tension (excitation or inhibition in Pavlov's sense). The nervous movements of the leg, and, in a more exaggerated form of the neurosis, the tremors observed in the rest intervals between stimulations are to be regarded as the protective operation of the neuromuscular system to prevent the nerve cells of the higher centers from being subjected to further strain.

The comparison between the maze method and the conditioned reflex method suggests a new field of research on behavior in which the rôle of free or spontaneous activity versus restricted activity is the main object of investigation. To gain a thorough understanding of how the nervous system may be subjected to dangerous strain (in which, according to Pavlov's theory, too much excitation or inhibition is required) it is necessary to carry the investigation outside the setting of the conditioned reflex and to determine quantitatively the relation between the total daily spontaneous activity of a particular animal and its ability to form positive and negative conditioned reflexes when spontaneous activity is prevented through training. Does continual restlessness in an animal species betoken a nervous system incapable of adjusting itself to intricate environmental situations?

A comparative study of the formation of the conditioned reflex in the dog, pig, sheep, goat and rabbit is already in progress,<sup>5</sup> but it is desirable to go further and to make a careful comparative study of spontaneous activity in the same species.

An interesting problem is presented by the fact that all the neuroses produced experimentally in sheep were finally of an excitatory nature, although in two animals (sheep 1 and 3) a preliminary inhibitory phase was observed. Why does not Pavlov's inhibitory or somnolent type of neurosis develop in sheep? Is it because they do not sleep as dogs do? As a part of the general program just sketched a comparative study of sleep in the various mammals is suggested.

In this report we are primarily interested in determining the conditions responsible for the derangements of behavior in animals rather than in formulating a new theory to account for them.

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5. Liddell, H. S.; James, W. T., and Anderson, O. D.: *The Comparative Physiology of the Conditioned Motor Reflex*, Comparative Psychology Monograph 11, Baltimore, Johns Hopkins Press, 1934.



A detailed analysis of all the factors responsible for the experimental neurosis observed in our sheep cannot at present be supplied, but we believe that definite progress has been made in practical experimental procedure, if not in theory. The practical advantages of our experimental approach to the problem of functionally produced nervous disorders in animals seem to be as follows:

1. The choice of the sheep as a subject for conditioning experiments has proved fortunate for a number of reasons. Its ordinary span of life of about twelve years favors experiments of long duration while the cost of its maintenance is not excessive. Above all, it is a docile animal whose behavior is far less complex than that of the dog or cat.

2. The circumstances which led us from the innocuous training procedure of maze-learning to the forming of a conditioned reflex by which functional disturbances of long duration can be produced in the sheep directed our attention to the significance of spontaneous activity in the work of the nervous system. Its possible theoretical importance for the understanding of the experimental neurosis has been discussed.

3. The use of the motor defense reaction in conditioning can be considered as strategic for the analysis of the experimental neurosis because the motor manifestations (including speech) of a disordered nervous system are of central interest and value to the clinician. Pavlov's account of the nervous disturbances in the dog expressed in terms of more or less salivary secretion directs attention away from the more striking neuromuscular manifestations. Even though he described the dog's general behavior Pavlov made no serious attempt at quantitative description or graphic recording of the abnormal postures and movements appearing in the neurotic animal. Previous objections to the use of the defensive motor conditioned reflex on the ground that the conditioned and unconditioned movements of the limb cannot be described quantitatively are now invalid. By connecting the reacting limb with a Fick work accumulator not only can the movements of the leg be recorded on the kymograph by a myograph lever (figs. 2 to 18) but their magnitude can be quantitatively estimated. The total revolution of the wheel of the accumulator during the conditioned signal can be observed by the experimenter just before the shock is administered, and then with a little practice the additional rotation of the wheel when the shock is given permits him to record at once separate estimates of the magnitude of the conditioned reflex and of the unconditioned flexion of the leg in response to the shock. In testing neurotic animals, as soon as the reaction to shock is over the accumulator wheel may be set at zero, and an estimate of the total amount of movement of the forelimb during the rest interval may be determined. Thus, measurement of the extent of restlessness in the laboratory is possible. The

temporal distribution of the restless movements appears on the kymograph tracing.

The attention of the reader must be directed to further inviting possibilities suggested by our technic for analyzing behavior. By emphasizing the quantitative aspect of neuromuscular reactions observed in experimentally generated derangements of behavior, our method suggests precise testing of the effect of drugs and hormones on the adequacy of psychobiologic adjustment. Two instances of preliminary experiments from this laboratory may serve to illustrate what is meant. One example is selected from a series of experiments recently performed by one of us (O. D. Anderson) on the action of drugs. When alcohol is administered to a sheep suffering from an experimental neurosis, the first effect is to diminish and then to abolish the conditioned movement of the leg, but at the same time the nervous movements during the rest periods are exaggerated. These diminish and disappear, and finally the motor reaction to shock fails. These three seemingly separate components of the neurotic animal's behavior reappear in reverse order as the effect of the alcohol disappears. Thyroidectomized sheep confronted by predicaments in the laboratory which sufficed to induce experimental neuroses in normal sheep were brought to the preliminary or negative phase of the neurosis, and sometimes a temporary flare-up of the usual excitatory condition was observed. In such cases continued training, which in the usual neurotic sheep would aggravate the symptoms, led to a complete subsidence of the developing neurosis, and the athyroid animals achieved a steady level of performance.

#### CONCLUSION

It has proved possible to produce derangements of behavior of an enduring nature in sheep by the use of the motor conditioned reflex method in which the animal is trained to expect a mild electric shock when certain signals (stimuli) are given. We identify these nervous disturbances with the experimental neurosis induced in dogs by the salivary conditioned reflex method described by Pavlov. Our technic has the advantage of centering attention on the neuromuscular reactions accompanying this abnormal state. A tentative analysis of the experimental conditions responsible for these neuroses in animals is given, and a program for future investigation is sketched.

## MOULAGES

THEIR PREPARATION AND SERVICE TO THE NEUROPATHOLOGIST

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It is the experience of every one concerned with the study of anatomic alterations in the central nervous system that in the more or less obscure conditions exhaustive histologic studies often prevent the preservation of the gross specimen. This difficulty is readily recognized in any example of widespread disease of the brain, particularly if the lesion is neoplastic and as such deforms the brain or disrupts many of its parts. In such an instance it is often necessary to cut the brain into numerous segments and to dismember it almost beyond recognition. In order to preserve a record of the gross appearance of the disease process the brain is usually photographed before it is sectioned. This procedure, however, does not provide a true three-dimensional view of the organ. Thus, on many occasions, to preserve the brain for subsequent gross topographic studies it is allowed to remain uncut except for the removal of small fragments for the purpose of routine histologic studies. To remedy this condition von Economo, in collaboration with Poller,<sup>1</sup> devised a method which allows the preparation of a permanent true cast of the specimen in toto. When this is done one is no longer prevented from further dismembering the specimen if so desired. I find this method highly useful, not only because it provides permanent records of gross specimens but also because the casts serve as useful teaching material. The method obviates the old-fashioned preparation of museum specimens. Instead of the perishable, unwieldy and fragmentary wet specimens, a more permanent, easily handled, good reproduction of the original specimen may be placed in the hands of the student for thorough investigation. For some time the more satisfactory methods of reproduction of anatomic material were too costly. Having developed an inexpensive casting substance, I thought it advisable to publish its formula and describe its use so as to open the way for its wider application in the preparation of museum specimens.

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From the Division of Neuropathology, the Mount Sinai Hospital.

This study was aided by a grant from the New York Academy of Medicine.

Demonstrated before the meeting of the American Neurological Association, Washington, D. C., May 1933, and before the post-graduate fortnightly session of the New York Academy of Medicine, 1932 and 1933.

1. Poller, Alphons: *Das Pollersche Verfahren zum Abformen an Lebenden und Tote, sowie an Gegenständen*, Berlin, Urban & Schwarzenberg, 1931.

## METHOD

A brief summary of the method will be given here, as a more detailed description in which the original casting material is employed will be found in the little volume published by von Economo's collaborator. It is described as applied to the brain but can be utilized in the preliminary preparation of casts of any other organ or structure.

1. *Treatment of the Specimen to Be Reproduced.*—A. The brain can be reproduced in the fresh state, but as it is then somewhat pliable and often exceedingly soft it does not lend itself to this method of reproduction. The fixed brain is preferable, but the formaldehyde which is commonly used for fixation affects the substance used for the preparation of the mold, and hence it is advisable to make

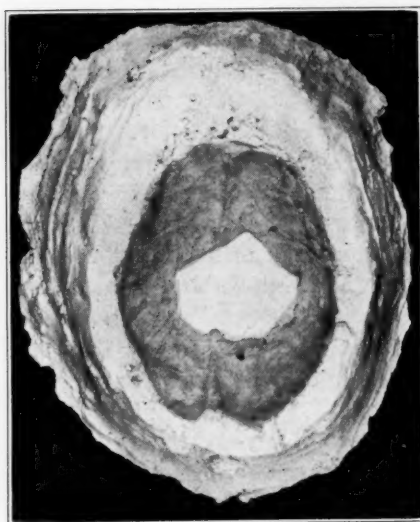


Figure 1



Figure 2

Fig. 1.—Plaster of paris base to provide a fixed position for the specimen to be molded.

Fig. 2.—Specimen resting in the plaster of paris base. Silk threads are placed to indicate the extent of each of the several segments of the negocoll capsule (mold).

every effort to wash out the formaldehyde before the molding substance is brought into contact with the tissue. The removal of the formaldehyde can be accomplished by washing the brain in running water for twenty-four hours or, even better, by adding a small amount of ammonia in the first washing.

B. In order to protect the brain from drying in the course of the preparation of the mold and to insure a better separation of the mold from the enclosed brain, which adheres to the molding material, it is necessary to cover the brain with liquid petrolatum. It has been suggested that the brain be allowed to soak in this liquid, but I have found that thoroughly covering the substance with liquid petrolatum by means of a soft brush is sufficient.

2. *The Supporting Plaster Base.*—It will be found convenient to prepare a base of plaster of paris on which the brain may rest while the molding material is applied. For the preparation of such a base the dorsal convexity of the brain is coated with liquid petrolatum before plaster of paris is poured over it. When the latter is hardened, it is freed from the brain and its interior is covered with shellac (fig. 1).

3. *Steps in the Preparation of the Negative (Mold).*—A. Material: The molding substance, negocoll,<sup>2</sup> recommended by von Economo gives excellent results. Recently, however, a new substance was described<sup>3</sup> which is said to be satisfactory and can be prepared at a substantial reduction in the cost. The negocoll is heated in a double boiler, from 4 to 5 ounces (118 to 148 cc.) of water being added to each pound (373 Gm.) of the dry ground substance. When it acquires a uniform semiliquid consistency it is ready for use.

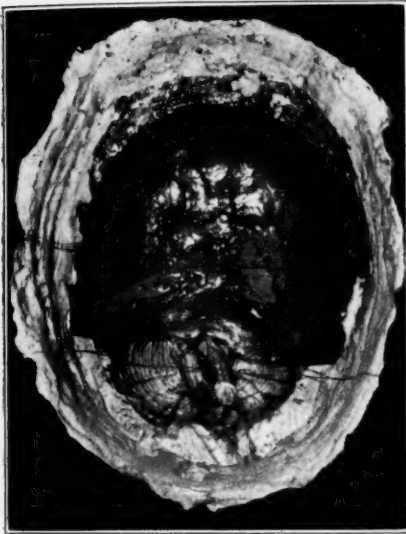


Figure 3



Figure 4

Fig. 3.—Specimen as in figure 2, showing the appearance of the first application of the negocoll before it is cut by the thread.

Fig. 4.—Specimen as in figure 3, showing the cut edge of the first segment of the mold.

B. *Planning the Parts of the Mold:* Before the molding material is applied to the brain, the latter must be studied carefully for undercuts. The number of the undercuts determines the number of segments which will make up the mold. One should not hesitate to make as many segments as is deemed necessary, as it does not interfere with the preparation of the cast.

2. Negocoll and celerit may be obtained from the Kern Co., 136 Liberty Street, New York. From 1½ to 2 pounds (from 559 to 746 Gm.) of this material and about 1 pound (373 Gm.) of celerit are required for the preparation of a cast of an average brain. These materials can be used repeatedly.

3. Gross, Paul: A New Negative Mass for Making Accurate Plastic Reproductions, *Arch. Path.* **16**:869 (Dec.) 1933.

The number of segments of the projected mold having been definitely mapped out, the boundaries of each are indicated by placing black silk threads over the specimen (fig. 2). These threads are useful not only in demarcating the extent of a given segment but in obtaining clean and sharply cut surfaces of the segment or segments after the molding material is hardened.

C. Making of the Mold: The semiliquid material is plastered over the specimen, covering an area somewhat beyond the lines indicated by the silk threads. It is then allowed to harden, this process requiring about ten or fifteen minutes. When the process of hardening is completed, the loose ends of a given thread are simultaneously raised and drawn together so as to cut the molding material. In this fashion the preparation of a segment is completed (figs. 3 and 4). Several indentations are then made on the cut surface of the segment so as to provide strong joints with the segment which is to be prepared subse-

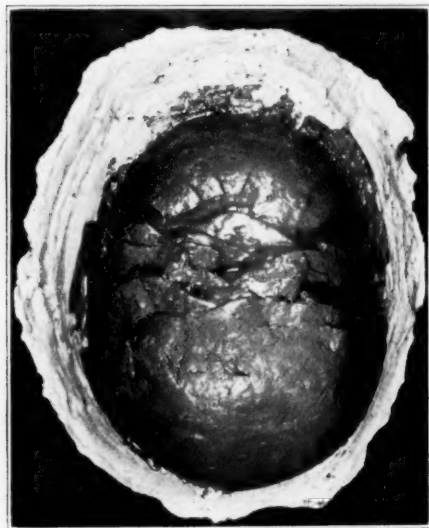


Figure 5

Fig. 5.—Specimen as in figure 4, showing the ventral surface of the specimen completely covered by negocoll.

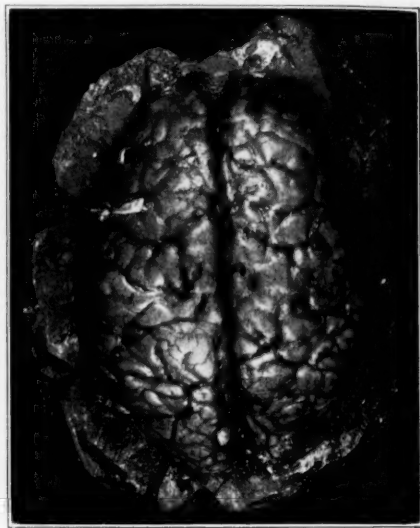


Figure 6

Fig. 6.—Specimen freed from the plaster of paris base, resting on the negocoll cover, shown in figure 5. The exposed dorsal surface is now to be covered with negocoll.

quently. This is necessary in order to prevent dislodgment of segments while the casting is being completed. The same steps should be carried out with the preparation of the subsequent segments until the entire object is surrounded by the negocoll (figs. 5, 6 and 7). If a section is highly irregular, larger numbers of segments are required, at times as many as from six to eight.

Since the hardened negocoll is brittle, it is necessary to provide an additional support or a capsule to protect the material from the rather violent handling incident to the casting. Thus, another substance of greater consistency is provided. It is called "celerit." It may not always be necessary to use this substance since some form of museum sealing wax makes a satisfactory substitute. It is spread



over the mold in a thin layer without completely covering it (fig. 8). In the preparation of this reinforcing jacket it is advisable to incorporate strips of gauze with the mass in order to add to its strength.

Up to this point a mold and its surrounding jacket have been prepared. The jacket is then removed and the mold opened. At times it will be difficult to find the cut edges of the several parts of the mold, and their separation may likewise be somewhat difficult. Under these circumstances a gentle compressing force is applied; the segments will separate (fig. 9) and the enclosed specimen will be liberated. When the specimen has been removed, the mold is reassembled. An open window is left by excluding temporarily a small segment through which the casting material is introduced.

4. *Casting*.—A satisfactory casting mixture called hominit was recommended by von Economo. This is liquefied by heat, and when brought to a point where it is uniformly semiliquid, it is poured into the partially open mold. When the mold is filled to about two thirds of its capacity<sup>4</sup> the last segment is introduced, and the

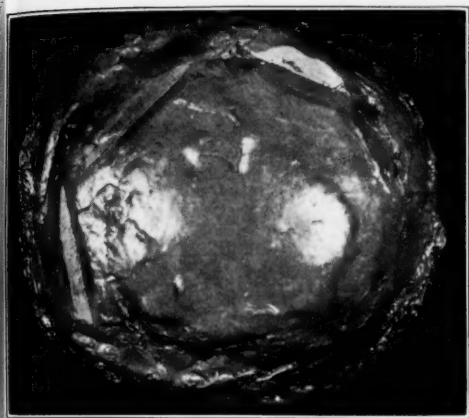


Figure 7



Figure 8

Fig. 7.—Dorsal surface covered with negocoll. The negocoll mold is now completed.

Fig. 8.—Negocoll capsule (mold) reinforced by celerit.

other half of the reinforcing jacket is put on. The entire mold is then slowly revolved so as to bring all the other surfaces in contact with the casting material. This manipulation must be continued for from five to ten minutes until the casting material begins to cool and is in a condition to retain the form it has acquired. It then may be left at room temperature to cool further or may be submerged in ice water to bring about a more rapid solidification of the cast. One-half hour should be allowed for complete chilling of the specimen before liberation of the cast. If the mold is carefully removed segment by segment, it may be preserved for the preparation of other casts.

The next step is to remove an occasional seam or bleb which has formed in the process of casting. It may at times also be necessary to deepen or widen a groove or to accentuate a structure. This is necessary only when the work has been carried out carelessly. The coloring of the specimen is best carried

4. The completed cast will thus be hollow and lighter.



Fig. 9.—Mold separated into its several segments.



Fig. 10.—Ventral view of finished cast. Compare with the original specimen resting on the plaster of paris base, shown in figure 1.

out by means of oil paints and is limited to the bringing out of blood vessels or the tinting of different areas. This is followed by the application of a protective covering of shellac, and the specimen is then complete (fig. 10).

Less costly substitutes for hominit are now available. In selecting a substitute one should guard against material which may injure the quality of the negocoll. The latter may be used repeatedly for a large series of molds, but when affected by loose particles of plaster of paris will no longer be efficacious. Such a casting mass has now been developed by me and used satisfactorily in the preparation of moulages at a cost which is no longer prohibitive. It is readily prepared with the use of inexpensive ingredients:

	Parts
White wax, U. S. P.....	10
Rosin, U. S. P.....	4
Plaster of paris (calcium sulphate, desiccated).....	5
Hydrated finishing lime.....	1

The wax and rosin are placed in a large enameled utensil with a wide opening and heated over a flame until liquefied. The plaster of paris is then slowly added by sprinkling it over the surface of the liquid mixture of wax and rosin. The hydrated finishing lime is then introduced in a similar way. Spilling of the extremely hot liquid mass, owing to the effervescence caused by the lime is likely to occur at this time and may be avoided by putting into the mixture a short piece of rubber tubing of large caliber which will act as a vent for the liberated gas.

## SPECIAL ARTICLES

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### NEUROPSYCHIATRIC ASPECTS OF CALCIUM AS VIEWED FROM THE DIFFERENT LEVELS OF THE PERSONALITY

REVIEW OF THE LITERATURE

JOSEPH J. MICHAELS, M.D.

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During the course of laboratory<sup>1</sup> and clinical<sup>2</sup> studies on calcium in relation to neuropsychiatric problems, there was occasion to review the literature in this complicated sphere. It is my purpose to abstract this enormous amount of material in a somewhat integrated and conceptual manner, and it is hoped that a dynamic point of view has been brought to bear on this problem. Immediately the question arises: Where shall the limits be drawn as to what is inclusive and pertinent and what is exclusive and unrelated to the subject? The present controversial discussions of the respective boundaries of the fields of neurology and psychiatry attest to the difficulties involved. However, it is my belief that the nature of the problem must determine the extent and limitations of the investigation.

Where are the points of contact between calcium (in itself a most inert substance) and the personality as a whole (a dynamic energy system), and where do they become unrelated and disparate phenomena? When the functions of the nervous system are regarded as integrative activities, where can one fractionate events and decide which events are more important than others? With scientific progress, facts (constants) are valued not so much in their isolation as in their relationship to each other and in the meaning that they bring to the total situation (irreducible variables). The more complex the problem, the less likely is a single factor to be found as the dominating causal one. Usually there are a number of subtle interreacting forces, a plurality of causes, that

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1. Searle, O. M., and Michaels, J. J.: A Comparison of the Calcium Content of Human Cerebrospinal Fluid with That of an Ultrafiltrate of Serum, *Am. J. Physiol.* **103**:455 (Feb.) 1933.

2. Michaels, J. J., and Searle, O. M.: Calcium of the Cerebrospinal Fluid, Blood Serum and Serum Ultrafiltrate: Its Relation to the Clinical Findings in Eighty Neuropsychiatric Patients, *Arch. Neurol. & Psychiat.* **33**:330 (Feb.) 1935.

seriously complicate the analysis. This finds its most complete expression in the human personality.

Mental diseases are now being considered as individual psychobiologic disorders. Even from the biologic aspect, it is insufficient to study only the brain and the spinal cord and its coverings; such factors as the influence of the electrolytic milieu, the vegetative nervous system and the endocrine glands with their repercussions throughout the organism must be taken into account. The interrelations of psychic influences and the soma are necessary concomitants.

#### PHYSIOLOGIC CONSIDERATIONS

*Capillary, Cellular and Meningeal Permeability; Diffusibility of Calcium.*—The universality of action of calcium can be gathered from an article by Clowes,<sup>3</sup> in which he concluded that salts of calcium appear to promote, and alkalis and salts of sodium to inhibit reversal or transposition of phase relations in widely diversified heterogeneous systems. Pottenger<sup>4</sup> stated that calcium becomes an important link not only in the activity of the cell but in correlating and integrating action in the various vegetative organs and in the body as a whole. Petersen and Levinson<sup>5</sup> expressed the belief that the concentrations of calcium and potassium are indicative of the swing of the pendulum of cellular activity. The relationship of calcium metabolism to cellular and capillary permeability is a physiologic chemical consideration of the utmost importance. Recent studies on the hemato-encephalic barrier are specific applications of this fundamental problem; these have been mostly carried on with the bromide method (Walter,<sup>6</sup> Malamud and his co-workers<sup>7</sup> and Katzenelbogen.<sup>8</sup> When one is dealing with the introduction of a foreign agent, it seems that this method will be only of static value; whereas, when the natural constituents, such as calcium, potassium, etc., are studied, one will have a better indication of the dynamic situation.

3. Clowes, G. H. A.: Protoplasmic Equilibrium: I. Action of Antagonistic Electrolytes on Emulsions and Living Cells, *J. Physical Chem.* **20**:407, 1916.

4. Pottenger, F. M.: The Relationship of the Ion Content of the Cell to Symptoms of Disease with Special Reference to Calcium and Its Therapeutic Application, *Ann. Clin. Med.* **2**:187 (Nov.) 1928.

5. Petersen, W. F., and Levinson, S. A.: Skin Reactions, Blood Chemistry and Physical Status of "Normal" Men and of Clinical Patients, *Arch. Path.* **9**:147 (Jan.) 1930.

6. Walter, F. K.: Studien über die Permeabilität der Meningen: I., *Ztschr. f. d. ges. Neurol. u. Psychiat.* **95**:522, 1925.

7. Malamud, W.; Fuchs, D. M., and Malamud, N.: Barrier Between the Blood and the Cerebrospinal Fluid: I. Changes in Permeability in Mental Disease, *Arch. Neurol. & Psychiat.* **20**:780 (Oct.) 1928.

8. Katzenelbogen, S., and Goldsmith, H.: The Hemato-Encephalic Barrier: The Diagnostic Value of the Bromide Test in Mental Diseases, *Am. J. Psychiat.* **10**:1045 (May) 1932.

This immediately gives rise to the question as to the nature of the function of the meningeal barrier in regard to the spinal fluid, that is, whether the latter is a dialysate or a secretion. Fremont-Smith,<sup>9</sup> wholly in favor of the dialysate theory, has reviewed this subject adequately from a clinical standpoint. Greenberg<sup>10</sup> stated: "His results point to the conclusion that when the blood calcium is at a normal stable level there is an approximate approach to an equilibrium between blood and spinal fluid calcium and the spinal fluid is then a close measure of the diffusible calcium. But on the other hand when blood constituents are undergoing marked fluctuations the spinal fluid calcium does not keep pace." Hertz,<sup>11</sup> from his observations on parathyroidectomized dogs, arrived at almost identical conclusions. Herbert<sup>12</sup> showed that in cases of hypocalcemia and in hypercalcemia in human beings the calcium content of the spinal fluid remains relatively constant in spite of wide variations in the calcium content of the serum. Matsushashi,<sup>13</sup> from experiments on 4 dogs, concluded that the hypocalcemia caused by the total extirpation of the parathyroids has a slight effect on the choroid plexus, as it permits a little more sugar and chloride to pass than usual, while little change occurs in the nonprotein nitrogen and no change in the calcium of the spinal fluid. Marrack and Thacker<sup>14</sup> expressed the belief that the calcium of the spinal fluid is in the form of ions and gives an approximate figure for the calcium ion concentration in other body fluids, which is slightly low, owing to Donnan's equilibrium and possibly to the reduction of calcium ion activity by protein.

Cameron and Moorhouse<sup>15</sup> were the first to suggest that the spinal fluid calcium represents the diffusible calcium content of the blood

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9. Fremont-Smith, F.: The Nature of the Cerebrospinal Fluid, *Arch. Neurol. & Psychiat.* **17**:317 (March) 1927.

10. Greenberg, D. M.: A Comparison of Ultrafiltrable Serum Calcium and Cerebrospinal Fluid Calcium in Humans, *Proc. Soc. Exper. Biol. & Med.* **27**:514 (March) 1930.

11. Hertz, W.: Die Verteilung des Kalkes im Serum, *Biochem. Ztschr.* **217**:337, 1930.

12. Herbert, F. K.: The Total and Diffusible Calcium of Serum and the Calcium of Cerebrospinal Fluid in Human Cases of Hypocalcemia and Hypercalcemia, *Biochem. J.* **27**:1978, 1933.

13. Matsushashi, M.: The Influence of Various Drugs upon the Chemical Constituents of Liquor Cerebro-Spinalis in Dogs, *Jap. J. M. Sc. Tr., IV., Pharmacol.* **3**:53 (March) 1929.

14. Marrack, J., and Thacker, G.: State of Calcium in Body Fluids, *Biochem. J.* **20**:580, 1926.

15. Cameron, A. T., and Moorhouse, V. H. K.: The Tetany of Parathyroid Deficiency and the Calcium of the Blood and Cerebrospinal Fluid, *J. Biol. Chem.* **63**:687, 1925.



serum. Cantarow,<sup>16</sup> accepting this point of view, stated: "Changes in the calcium content of spinal fluid obviously may be due to alteration in one or both of two variable factors; namely, the diffusibility of the blood calcium and the permeability of the cell membrane interposed between the blood stream and the subarachnoid system." He added: "The ratio of diffusible to nondiffusible, or more correctly, of diffused to non-diffused, is an expression of the distribution of the calcium between the capillaries and the tissues." This seems to be too simple a statement of a complex biologic process which is at present little understood. Greenberg and Gunther<sup>17</sup> concluded that when the blood calcium level is increased by an injection of parathyroid extract, the increase is reflected in both the diffusible and the nondiffusible fraction; when the increase is produced by a calcium-containing compound, the increase takes place only in the diffusible calcium. Hence it is necessary to know the various calcium partitions before conclusions can be drawn as to the efficacy of drugs administered to increase the calcium.

In the accompanying table is a comparative statistical analysis of the values for the calcium content of the spinal fluid, blood serum and serum ultrafiltrate derived from previous data<sup>1</sup> and those calculated by Dr. Olive M. Searle from similar figures in the more recent literature. Both in range and in standard deviation our values for serum calcium were more variable than those of the remarkably constant normal series of Merritt and Bauer,<sup>18</sup> although our mean value was close to theirs. Our calcium figures for spinal fluid are strikingly similar to theirs and to those of Cantarow<sup>16</sup> for normal subjects. In contrast are the values for the abnormal groups of Merritt and Bauer,<sup>18</sup> Cantarow<sup>16</sup> and Watchorn and McCance.<sup>19</sup> The ratios of spinal fluid calcium to serum calcium and the coefficients of correlation (Pearson's product-moment method) are of the same order for Merritt and Bauer's<sup>18</sup> normal series and for ours and show a definite tendency for the values

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16. Cantarow, A.: Calcium Studies: The Relationship Between the Calcium Content of the Cerebrospinal Fluid and Blood Serum, *Arch. Int. Med.* **44**:670 (Nov.) 1929.

17. Greenberg, D. M., and Gunther, L.: Diffusible Calcium of the Blood Stream: V. Influence of Agents Which Affect Blood Calcium on Calcium Distribution and Inorganic Phosphate of the Serum, *Arch. Int. Med.* **50**:855 (Dec.) 1932.

18. Merritt, H. H., and Bauer, W.: The Equilibrium Between Cerebrospinal Fluid and Blood Plasma: III. The Distribution of Calcium and Phosphorus Between Cerebrospinal Fluid and Blood Serum, *J. Biol. Chem.* **90**:215 (Jan.) 1931.

19. Watchorn, E., and McCance, R. A.: VI. Inorganic Constituents of Cerebrospinal Fluid: II. The Ultrafiltration of Calcium and Magnesium from Human Sera, *Biochem. J.* **26**:54, 1932.

for spinal fluid calcium to vary with those for blood calcium. The values for the normal group of Fremont-Smith and his co-workers<sup>20</sup> and those for the small group of Hamilton<sup>21</sup> show an even higher degree of correspondence.

The range, mean and standard deviation from the mean of the calcium concentration of our ultrafiltrates are similar to the values noted by Gunther and Greenberg<sup>22</sup> and in marked contrast to those reported by Watchorn and McCance<sup>19</sup> for a group of pathologic serums of remarkably wide range in calcium concentration. The coefficient of correlation for the latter group,  $0.13 \pm 0.04$ , shows a marked correspondence of ultrafiltrate to total serum calcium. An inspection of the percentage ratios of our values for ultrafiltrate and spinal fluid calcium shows that in range they are surprisingly close to those of Greenberg<sup>16</sup> and McCance and Watchorn.<sup>23</sup>

Merritt and Bauer<sup>18</sup> concluded that in cases of meningitis the increased calcium content of the spinal fluid was due to the abnormal amount of protein in the fluid and the increased permeability of the meninges and choroid plexus. A ratio of 54 per cent was found between the calcium content of the aqueous humor and that of the serum in cats and a ratio of 60 per cent between the calcium content of the spinal fluid and that of the serum. Barrio,<sup>24</sup> in 14 cases, 11 of which were cases of syphilis, found the ratio of the spinal fluid calcium to the blood calcium to range from 45 to 50 per cent. Lickint<sup>25</sup> found the calcium content increased in the spinal fluid in most cases of meningitis and in 10 of 39 cases of syphilis of the central nervous system. Leopold<sup>26</sup> reported an increased permeability of the meninges to calcium in cases with abnormal findings in the spinal fluid.

20. Fremont-Smith, F.; Dailey, M. E.; Merritt, H. H.; Carroll, M. P., and Thomas, G. W.: The Equilibrium Between Cerebrospinal Fluid and Blood Plasma: I. The Composition of the Human Cerebrospinal Fluid and Blood Plasma, *Arch. Neurol. & Psychiat.* **25**:1271 (June) 1931.

21. Hamilton, B.: A Comparison of the Concentrations of Inorganic Substances in Serum and Spinal Fluid, *J. Biol. Chem.* **65**:101, 1925.

22. Gunther, L., and Greenberg, D. M.: I. The Diffusible Calcium and the Proteins of the Blood Serum in Jaundice, *Arch. Int. Med.* **45**:983 (June) 1930.

23. McCance, R. A., and Watchorn, E.: Inorganic Constituents of Cerebrospinal Fluid: Calcium and Magnesium, *Quart. J. Med.* **24**:371, 1931.

24. Barrio, N. G.: Comparative Studies in the Chemistry of Blood and Cerebrospinal Fluid: II. Calcium, Magnesium and Phosphorus, *J. Lab. & Clin. Med.* **9**:54 (Oct.) 1923.

25. Lickint, F.: Der Calciumgehalt des Liquor cerebrospinalis, *Klin. Wchnschr.* **13**:556, 1926.

26. Leopold, W.: Durchlässigkeitsverhältnisse der Blutliquorschranke, *Dissert. Greifswald*, 1928.

Comparative Statistical Analysis of Calcium Values for the Cerebrospinal Fluid, Serum and Serum Ultrafiltrate \*

Authors†	No. of Cases	Serum Calcium			Cerebrospinal Fluid Calcium			Cerebrospinal Fluid Calcium $\times 100$			Ultrafiltrate Calcium			Cerebrospinal Fluid Calcium $\times 100$		
		Mean			Range			Range, Mean, S. D.			Range			Range, Mean, S. D.		
		Range	Mean	S. D.	Range	Mean	S. D.	Range, Mean, S. D.	per Cent	per Cent	Range	Mean	S. D.	Range, Mean, S. D.	per Cent	per Cent
M and B																
(a).....	49	9.5-10.5	10.0	0.22	4.5-5.2	5.0	0.15	45-53	50	1.5	4.5-5.2	5.0	0.15	45-53	50	1.5
(b).....	30	6.8-11.0	9.1	0.71	3.4-6.2	5.0	0.47	46-68	55	3.7	3.4-6.2	5.0	0.47	46-68	55	3.7
C																
(c).....	68	9.2-11.0	....	0.30	4.5-5.5	....	0.17	....	....	....	....	....	....	....	....	....
(d).....	131	7.0-15.1	....	1.35	3.8-7.8	....	0.66	....	....	....	....	....	....	....	....	....
H.....	17	9.6-12.8	10.8	0.50	4.1-6.6	5.6	0.20	....	....	....	....	....	....	....	....	....
F. S.....	34	8.9-10.5	9.6	0.37	4.1-5.4	4.8	0.35	....	....	....	....	....	....	....	....	....
McC and W.....	13	9.3-11.6	10.6	....	4.6-6.1	5.3	....	43-58	50	....	4.5-7.0	5.5	....	79-133	104	....
G.....	9	8.1-10.6	9.6	....	4.3-5.2	4.9	....	45-64	51	....	3.7-6.5	4.8	....	71-128	97	....
W and McC.....	36	3.4-13.6	9.8	1.91	....	....	....	....	....	....	2.1-8.1	5.6	1.06	....	....	....
G and G																
(e).....	42	....	....	....	....	....	....	....	....	....	4.2-6.8	5.0	0.43	....	....	....
S and M																
(f).....	84	8.9-11.6	10.2	0.47	4.4-5.4	4.8	0.19	43-56	48	2.5	3.9-7.0	5.1	0.58	78-135	105	....
(g).....	63	8.9-11.2	10.2	0.47	4.4-5.4	4.8	0.19	43-56	48	2.5	3.9-6.2	5.0	0.58	84-133	104	....

\* All concentrations are expressed in milligrams per hundred cubic centimeters.

† M and B indicates Merritt and Bauer;<sup>18</sup> (a), normal; (b), meningitis and tuberculosis; C, Cantarow;<sup>19</sup> (c), normal; (d), abnormal; H, Hamilton;<sup>21</sup> F. S., Fremt-Smith;<sup>20</sup> McC and W, McCance and Watson;<sup>22</sup> G, Greenberg;<sup>23</sup> W and McC, Watson and McCance;<sup>19</sup> G and G, Gunther and Greenberg;<sup>22</sup> (e), normal; S and M, Searle and Michaels;<sup>1</sup> (f), unselected group; (g), selected group (organic disease omitted).

‡ S. D. indicates standard deviation from the mean. A rough approximation was obtained by dividing the range by 6.

§ r<sup>2</sup> indicates the Pearson coefficient of correlation.

*Neuromuscular Irritability.*—Loeb<sup>27</sup> demonstrated that monovalent sodium and potassium increase and that divalent calcium and magnesium ions decrease muscular irritability. MacCallum and his co-workers<sup>28</sup> found that the perfusion of calcium-free blood through an amputated leg caused nervous irritability. Quincke and Stein<sup>29</sup> reported that the chronaxia rises with calcium and falls with potassium. The bulk of effort supports the view that the diffusible fraction, and perhaps only its ionized component, is the portion of the serum calcium which is concerned with the control of neuromuscular irritability and that parathyroprival tetany is due to a diminution in this fraction (Cantarow<sup>30</sup>). In clinical cases of hypocalcemia, Cantarow<sup>30</sup> stated that in spite of occasional very low values for serum calcium (below 7 mg. per hundred cubic centimeters) increased neuromuscular excitability has never been observed. Therefore, the nondiffusible fraction of serum calcium has no influence on nervous and muscular irritability. Cantarow<sup>31</sup> expressed the belief that there appears to be some relationship between the concentration of the spinal fluid calcium and the manifestations of muscular hyperirritability in cases of uremia, such manifestations occurring with spinal fluid calcium below 4 mg.<sup>31a</sup> It is probable that the diminution in diffusible calcium increases neuromuscular irritability only so far as it represents a comparable diminution in ionized calcium (Liu;<sup>32</sup> Gunther and Greenberg<sup>33</sup>).

*Narcosis; Calcium in the Brain.*—Of physiologic interest has been the relationship of narcosis to the calcium of the blood. Heilig and Hoff<sup>34</sup> detected a definite increase in the concentration of calcium in the blood during sleep in 5 patients in a psychopathic hospital. Emer-

27. Loeb, J.: On an Apparently New Form of Muscular Irritability (Contact Irritability?) Produced by Solutions of Salts (Preferably Sodium Salts) Whose Anions Are Liable to Form Insoluble Calcium Compounds, *Am. J. Physiol.* **5**:362 (July) 1901.

28. MacCallum, W. G.; Lambert, R. A., and Vogel, K. M.: The Removal of Calcium from the Blood by Dialysis in the Study of Tetany, *J. Exper. Med.* **20**: 149, 1914.

29. Quincke, H., and Stein, J.: Chronaxie, *Ergebn. d. Physiol.* **34**:907, 1932.

30. Cantarow, A.: Calcium Metabolism and Calcium Therapy, Philadelphia, Lea & Febiger, 1931.

31. Cantarow, A.: Calcium Studies: VII. The Calcium and Inorganic Phosphorus Content of Cerebrospinal Fluid and Blood Serum in Chronic Glomerulonephritis with Uremia, *Arch. Int. Med.* **49**:981 (June) 1932.

31a. Wherever mg. is used, it refers to mg. per hundred cubic centimeters.

32. Liu, Shih-Hao.: The Partition of Serum Calcium into Diffusible and Non-diffusible Portions, *Chinese J. Physiol.* **1**:331 (July) 1927.

33. Gunther, L., and Greenberg, D. M.: The Diffusible Calcium of the Blood Stream in Tetany, *Arch. Int. Med.* **47**:660 (April) 1931.

34. Heilig, R., and Hoff, H.: Schlafstudien, *Klin. Wchnschr.* **4**:2194, 1925.

son<sup>35</sup> reported a definite increase, 18 per cent, in the serum calcium of the blood following ether anesthesia in dogs. In dogs anesthetized with ether Andrews and his co-workers<sup>36</sup> found that there was a progressive rise in the calcium content of the brain from 43 to 61 mg. per hundred cubic centimeters dry weight. Katzenelbogen,<sup>37</sup> from his findings that calcium was in a higher concentration in the hypothalamic region than in any other region of the brain during narcosis, suggested that calcium may take a certain part in the hypersomnic function ascribed to the hypothalamus. He<sup>38</sup> found that a decrease in the calcium content of the blood serum was characteristic of narcosis, which is in complete agreement with Cloëtta and Thomann.<sup>39</sup> In experimental studies on 20 cats during sleep induced by diallyl barbituric acid, Katzenelbogen<sup>40</sup> found that a decrease in the spinal fluid calcium followed a decrease in the blood calcium, which he also considered characteristic of hypnotic sleep. Katzenelbogen and Meehan<sup>41</sup> reported a consistent association of the syndrome of bulbocapnine intoxication with a decrease in the blood calcium content.

In 1905, Quest<sup>42</sup> stated that the calcium content in the brain is very high at birth and decreases rapidly as soon as the brain begins to function and that in children dying of tetany the amount of calcium in the brain is much lower. Hess and his co-workers,<sup>43</sup> in criticizing Quest's<sup>42</sup> results, mentioned that a sharp distinction will have to be drawn between the results obtained in the cases of infants who had preliminary rickets and the values noted in those exceptional cases in which the tetany was

35. Emerson, W. C.: The Effect of Ether Anaesthesia and Shock on the Calcium Content of the Blood, *J. Lab. & Clin. Med.* **14**:195 (Dec.) 1928.

36. Andrews, E.; Petersen, W. F., and Klein, R. I.: Calcium Changes in the Brain in Ether Anesthesia, *Ann. Surg.* **92**:993 (Dec.) 1930.

37. Katzenelbogen, S.: Calcium Content of the Brain and Its Distribution in Various Regions During Diallylbarbituric Acid Narcosis, *Arch. Neurol. & Psychiat.* **28**:405 (Aug.) 1932.

38. Katzenelbogen, S.: The Blood Electrolyte Changes in Narcosis with Special Reference to Calcium and Potassium, *Arch. Neurol. & Psychiat.* **24**:525 (Sept.) 1930.

39. Cloëtta, M., and Thomann, H.: Chemisch-physikalische Untersuchungen zur Theorie der Narkose, *Arch. f. exper. Path. u. Pharmacol.* **103**:260, 1924.

40. Katzenelbogen, S.: The Distribution of Calcium Between Blood and Cerebrospinal Fluid in Sleep Induced by Diallyl-Barbituric Acid, *Arch. Neurol. & Psychiat.* **27**:154 (Jan.) 1932.

41. Katzenelbogen, S., and Meehan, M. C.: The Chemistry of the Blood and the Cerebrospinal Fluid, With Special Reference to Calcium, in the Cataleptoid State Induced by Bulbocapnine: The Combined Effect of Bulbocapnine and Some Other Drugs, *J. Pharmacol. & Exper. Therap.* **47**:131 (Jan.) 1933.

42. Quest, R.: Ueber den Kalkgehalt des Säuglingsgehirns und seine Bedeutung, *Jahrb. f. Kinderh.* **61**:114, 1905.

43. Hess, A. F.; Gross, J.; Weinstock, M., and Berliner, F. S.: The Calcium and Phosphorus Content of the Brain in Experimental Rickets and Tetany, *J. Biol. Chem.* **98**:625 (Nov.) 1932.

primary. In rats they failed to find a direct relationship between tetany brought about by parathyroidectomy and a decrease in the calcium content of the brain. MacCallum and Voegtlin<sup>44</sup> found that the calcium content was lowered 40 per cent in the cerebrum and was slightly less in the cerebellum and medulla following parathyroprival tetany. Trendelenburg and Goebel,<sup>45</sup> in reviewing the early pertinent literature, concluded that the evidence pointing to a diminution of calcium in the brain in tetany in children and in experimentally produced tetany in animals was indefinite and inconclusive. Kaufman and Laskowski<sup>46</sup> demonstrated that in young birds the calcium content of the brain decreases during growth and increases after growth has ceased and that the potassium-calcium ratio increases during growth and decreases when the birds are fully grown. Eaves<sup>47</sup> concluded that an increase of the calcium in the brain tissues is relatively uncommon, tending to occur when there is gliosis without wasting of the brain; interestingly, in cases of Huntington's disease the calcium content was consistently low; in most cases of epidemic encephalitis it was at or above the upper limit. Magnus-Levy<sup>48</sup> found 10.6 mg. of calcium in 100 Gm. of fresh substance in the brain of a healthy person committing suicide at the age of 37. Heubner and Rona<sup>49</sup> reported a range of from 7 to 11 mg. per hundred cubic centimeters of calcium oxide in the fresh substance of the brains of cats.

Sabbatini,<sup>50</sup> in 1901, observed that the local application of a solution of calcium salts to the cortical motor area resulted in a decided diminution in electrical excitability and that increased irritability was produced by the introduction of a calcium-precipitant anion, such as oxalate, or of one which decreases its ionization, such as citrate. Salant and Swanson<sup>51</sup> could not corroborate the latter explanation of Sabbatini's.

44. MacCallum, W. G., and Voegtlin, Carl: On the Relation of Tetany to the Parathyroid Gland and to Calcium Metabolism, *J. Exper. Med.* **11**:118, 1909.

45. Trendelenburg, P., and Goebel, W.: Tetanie nach Entfernung der Epithelkörperchen und Kalziummangel im Blute, *Arch. f. exper. Path. u. Pharmacol.* **89**:171, 1921.

46. Kaufman, L., and Laskowski, M.: Wachstumsgeschwindigkeit und K: Ca-Quotient, *Biochem. Ztschr.* **242**:424, 1931.

47. Eaves, E. C.: Some Observations on Calcium and Phosphorus in the Brain in Different Conditions, *Brit. J. Exper. Path.* **12**:113 (April) 1931.

48. Magnus-Levy, A.: Ueber den Gehalt normaler menschlicher Organe an Chlor, Calcium, Magnesium und Eisen sowie an Wasser, Eiweiss und Fett, *Biochem. Ztschr.* **24**:363, 1910.

49. Heubner, W., and Rona, P.: Ueber den Kalkgehalt der Organe bei kalkbehandelten Katzen, *Biochem. Ztschr.* **135**:248, 1923.

50. Sabbatini, L.: Importanza del calcio che trovasi nella corteccia cerebrale, *Riv. sper. di freniat.* **27**:946, 1901.

51. Salant, W., and Swanson, A. M.: Observations on the Action of Tartrates, Citrates and Oxalates: A Study in Tolerance, Cumulation and the Effect of Diet, *J. Pharmacol. & Exper. Therap.* **11**:133 (March) 1918.



Demole<sup>52</sup> showed that the introduction of calcium chloride into the brain tissue in cats invariably induced sleep, whereas the introduction of potassium chloride into the same cerebellar region was followed by a state of restlessness, stupor, muscular rigidity and epileptoid convulsions. Berggren and Moberg<sup>53</sup> repeated the experiments of Demole;<sup>52</sup> sleep was induced in cats by the injection of either calcium or potassium chloride and sometimes by merely inserting the needle. Their effective region was similar to that described by Demole. Cloëtta and Fischer,<sup>54</sup> in experiments on rats, cats, dogs and rabbits, found that the injection of calcium chloride into the infundibular region produced a state of sleep. Weed and Wegeforth<sup>55</sup> noted frequent neuromuscular phenomena of irritation and a peculiar psychic disturbance while saline solution (absence of calcium) was passing through the meninges of cats. Huggins and Hastings<sup>56</sup> produced a typical syndrome of contraction of the muscles and rigidity of the extensor muscles in dogs by the injection of sodium citrate into the cisterna magna. However, when calcium chloride or magnesium chloride was injected, the animals returned to a normal state.

#### INTERRELATIONSHIP OF ELECTROLYTES, VEGETATIVE NERVOUS SYSTEM, ENDOCRINE GLANDS AND PSYCHE

The striking relationship of autonomic imbalance to neuropsychiatric disorders needs no further discussion (Claude and his co-workers,<sup>57</sup> Kantor,<sup>58</sup> Bockus and his co-workers<sup>59</sup> and Murray<sup>60</sup>). Appel and Palmer<sup>61</sup> stated that persons with manic-depressive psychoses show

52. Demole, V.: *Pharmakologisch-anatomische Untersuchungen zum Problem des Schlafes*, Arch. f. exper. Path. u. Pharmacol. **120**:229, 1927.

53. Berggren, S., and Moberg, E.: *Experimentelle Untersuchungen zum Problem des Schlafes*, Acta psychiat. neurol. **4**:1, 1929.

54. Cloëtta, M., and Fischer, H.: *Ueber die Wirkung der Kationen Ca, Mg, Sr, Ba, K und Na bei intrazerebraler Injektion*. (Beitrag zur Genese von Schlaf und Erregung), Arch. f. exper. Path. u. Pharmacol. **158**:254, 1930.

55. Weed, R., and Wegeforth, Lewis H.: *Experimental Irrigation of the Subarachnoid Space*, J. Pharmacol. & Exper. Therap. **13**:317, 1919.

56. Huggins, C. B., and Hastings, A. B.: *Effect of Calcium and Citrate Injections into Cerebrospinal Fluid*, Proc. Soc. Exper. Biol. & Med. **30**:459 (Jan.) 1933.

57. Claude, H.; Santenaise, D., and Targowla, R.: *An Attempt at a Biologic Diagnosis of States of Excitement and Depression*, Arch. Neurol. & Psychiat. **13**:729 (June) 1925.

58. Kantor, J. L.: *Neurogenic and Psychogenic Disorders of the Alimentary Canal*, J. Nerv. & Ment. Dis. **70**:28 (July) 1929.

59. Bockus, H. L.; Bank, J., and Wilkinson, S. A.: *Neurogenic Mucous Colitis*, Tr. Am. Gastro-Enterol. A., 1928, p. 277.

60. Murray, C. D.: *Psychogenic Factors in the Etiology of Ulcerative Colitis and Bloody Diarrhea*, Am. J. M. Sc. **180**:239 (Aug.) 1930.

61. Appel, K. E., and Palmer, H. D.: *Ephedrine Circulatory and Glycemic Reactions in the Psychoses*, Arch. Neurol. & Psychiat. **27**:159 (Jan.) 1932.

reactions indicative of hypertonia of the sympathetic nerves and those with schizophrenia give responses varying from obtundity of the sympathetic nerves to frank vagotonia. Haskell and Cantarow,<sup>62</sup> from a study of Petersen's work, concluded that parasympatheticotonia (vagotonia) is associated with capillary dilatation, increased permeability and calcium deficiency in the tissues and that sympatheticotonia is accompanied by decreased permeability and a relative calcium excess. Cantarow<sup>63</sup> showed that in practically all patients with some manifestations of allergy or of autonomic imbalance, such as bronchial asthma, vasomotor rhinitis, angioneurotic edema and mucous colitis, the diffusibility of calcium (the diffusible fraction is that portion of the blood calcium which is capable of passing through the capillary wall and cell membrane) was increased. In 2 patients with spastic colon, 6 with mucous colitis and 7 with ulcerative colitis the diffusibility of calcium was found to be increased; "the evidence of a disturbance of calcium partition in these conditions serves to emphasize the fundamental relationship between autonomic balance, capillary permeability and electrolyte equilibrium." The asthmatic paroxysm is looked on as a condition of local vagotonia. Eppinger and Hess<sup>64</sup> suggested its association with a diminished ratio of calcium to sodium and potassium.

Berg and his co-workers,<sup>65</sup> Wollheim<sup>66</sup> and Leites<sup>67</sup> concluded that the equilibrium of both blood calcium and blood phosphorus was rendered less stable by division of the sympathetic or the parasympathetic nerves. In contrast, the findings of Bacq and Dworkin<sup>68</sup> agreed with those of Lamelas<sup>69</sup> to the effect that the absence of sympathetic nerves has no apparent effect on the calcium level in the blood serum. In 1911,

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62. Haskell, B., and Cantarow, A.: Calcium and Parathyroid Therapy in Chronic Ulcerative Colitis, *Am. J. M. Sc.* **182**:180 (Feb.) 1931.

63. Cantarow, A.: The Diffusibility of Calcium in Bronchial Asthma and Allied Disorders and in Pulmonary Tuberculosis, *Am. J. M. Sc.* **179**:497 (April) 1930.

64. Eppinger, H., and Hess, L.: Vagotonia: A Clinical Study in Vegetative Neurology, translated by Walter Max Kraus and Smith Ely Jelliffe, ed. 2, New York, Nervous and Mental Disease Publishing Company, 1917.

65. Berg, B. N.; Hess, A. F., and Sherman, E.: Changes in the Percentage of Calcium and Phosphorus of the Blood Following Section of the Sympathetic and Vagus Nerves, *J. Exper. Med.* **47**:105 (Jan.) 1928.

66. Wollheim, E.: Vegetatives Nervensystem und Electrolytverteilung, *Biochem. Ztschr.* **151**:416, 1924.

67. Leites, S.: Ueber die Beziehungen zwischen dem vegetativen Nervensystem und den Elektrolyten K, Ca des Serums, *Biochem. Ztschr.* **166**:47, 1925.

68. Bacq, Z. M., and Dworkin, S.: The Action of Parathyroid Extract in Sympathectomized Animals, *Am. J. Physiol.* **95**:614 (Dec.) 1930.

69. Lamelas, J.: Blood Calcium After Sympathectomy, Adrenin Injections and Sham Rage, *Am. J. Physiol.* **93**:111, 1930.

Chiari and Fröhlich<sup>70</sup> claimed that the excitability of the sympathetic nervous system is markedly increased by diminishing the calcium content of the blood. Daniéopolu and his co-workers<sup>71</sup> attributed the inhibition of the movements of the abdominal viscera and diminution of tone of voluntary muscle to the exciting action of calcium on the sympathetic nerve endings. Baráth<sup>72</sup> concluded that the effect of calcium on man is manifested in a double (amphotropic) reaction; in the initial period there are strongly expressed symptoms of excitement of the vagus nerve of short duration, and these are followed by a less strongly expressed period of excitement of the sympathetic nerves of longer duration. Of special significance has been the theory of Kraus and Zondek,<sup>73</sup> who declared that the effect of calcium was analogous to that of an alteration of the sympathetic nerves and that the effect of potassium was similar to that of an alteration of the vagus nerve. Although there have been many reports to confirm their theory, there have also been authors who have opposed it (Jendrassik and Czike,<sup>74</sup> Bun-ichi,<sup>75</sup> Schretzenmayr<sup>76</sup> and Thomson and Collip<sup>77</sup>).

Fischer,<sup>78</sup> from experiments with decerebrated dogs, suggested that the calcium-regulatory center of the blood was situated in the floor of the third ventricle. Siciliani<sup>79</sup> concluded that when injuries involve the

70. Chiari, R., and Fröhlich, A.: Zur Frage der Nervenenerregbarkeit bei der Oxalatvergiftung, *Arch. f. exper. Path. u. Pharmacol.* **66**:110, 1911.

71. Daniéopolu, D.; Radovici, and Carniol, A.: Action de l'atropine et du calcium sur les réflexes viscéraux, *Rev. neurol.* **39**:228 (March) 1923.

72. Baráth, E.: On the Amphotropic Effect of Drugs upon the Vegetative Nervous System and on Their Physiologic and Clinical Significance, *Am. J. M. Sc.* **172**:107 (July) 1926.

73. Kraus, F., and Zondek, S. G.: Ueber die Durchtränkungsspannung (Mit besonderer Rücksicht auf die Bedeutung der Elektrolyte), *Klin. Wchnschr.* **1**:1773 (Sept. 2) 1922.

74. Jendrassik, L., and Czike, A.: Zum Chemismus der vegetativen Reizung: Weitere Versuche über die angebliche Rolle von Ionen, *Biochem. Ztschr.* **193**:285, 1928.

75. Bun-ichi, H.: Der Einfluss der Injektion von Chlorcalcium ins Tuber cinereum auf die Schweiss-Sekretion sowie Körpertemperatur, *Arch. f. exper. Path. u. Pharmacol.* **153**:291, 1930.

76. Schretzenmayr, A.: Ueber die Gefässtonuswirkung und den Angriffspunkt des Calciums, *Arch. f. exper. Path. u. Pharmacol.* **161**:630, 1931.

77. Thomson, D. L., and Collip, J. B.: The Parathyroid Glands, *Physiol. Rev.* **12**:309 (July) 1932.

78. Fischer, H.: Die Rolle des Calciums beim Zustandekommen von Narkose und Erregungszuständen und am völlig dezerebrierten Tier, *Arch. f. exper. Path. u. Pharmacol.* **138**:169, 1928.

79. Siciliani, G.: Amount of Calcium, Magnesium, Potassium, Phosphorus, Sodium and Chlorine in Blood After Cranial Injuries, *Arch. ital. di chir.* **27**:95 (Sept.) 1930; abstr., *J. A. M. A.* **96**:149 (Jan. 10) 1931.

base of the skull there is more likely to be a constant but transitory disturbance (at the most for thirty-six hours) of the electrolytic equilibrium. Glaser<sup>80</sup> found that psychic influence may change the calcium content of the blood of a subject as much as 2.16 mg. Kretschmer and Krüger<sup>81</sup> confirmed these findings. Schazilla and Abramov<sup>82</sup> concluded that the suggestion to a patient of a happy experience results in an elevation of the potassium-calcium ratio, and the suggestion of an illness, in a decrease. Tomasson and his co-workers,<sup>83</sup> in a series of carefully conducted examinations of persons with psychic disturbances, found that the potassium-calcium ratio showed alterations before the onset of the mental upset.

Petersen and Levinson<sup>5</sup> expressed the belief that there is a close parallelism of "nervousness," capillary permeability, permeability of the meningeal barrier and the potassium-calcium ratio. A most extreme conclusion was given by Kraus<sup>84</sup> when he stated that the ratio of calcium to potassium in the tissues is a real basis of the personality. W. Meyer<sup>85</sup> tried to bring these complex conceptions into relationship with cancer when he wrote on the vicious circle of the imbalance of the nerves, the endocrine glands, the serum salts and the psyche, constituting a systemic chronic irritation, as an influence in the systemic predisposition to cancer.

#### RELATED MEDICAL ASPECTS OF CALCIUM

*Ectodermal Tissues (Cutaneous and Ocular); Medical Diseases; Female Generative Metabolism.*—Petersen and Levinson,<sup>5</sup> with renewed emphasis on constitution, found that a prolonged blister time seems to be associated with a higher level of blood calcium. In a study of general correlations in 100 so-called normal men, specific correlations of the level of blood calcium were found with: the blister time, the blood sugar level, the resistance of the skin to electric current, the reaction to ice and the diameters of the wheal and flare of the reaction to epi-

80. Glaser, F.: Psychische Beeinflussung des Blutserum-Kalkspiegels, *Klin. Wchnschr.* **3**:1492, 1924.

81. Kretschmer, M., and Krüger, R.: Ueber die Beeinflussung des Serumkalkgehaltes in der Hypnose, *Klin. Wchnschr.* **6**:695 (April 9) 1927.

82. Schazilla, B. A., and Abramov, N. P.: Ueber die Wirkung der Hypnose auf das Verhältnis der K- und Ca-Elektrolyte im Blutserum, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **112**:54, 1928.

83. Tomasson, H.: Psychische Beeinflussung des Serumkalziumspiegels, *Klin. Wchnschr.* **3**:2055, 1924.

84. Kraus, F., quoted by Schilder, P.: The Somatic Basis of the Neurosis, *J. Nerv. & Ment. Dis.* **70**:502 (Nov.) 1929.

85. Meyer, W.: *Cancer: Its Origin, Its Development and Its Self-Perpetuation. The Therapy of Operable and Unoperable Cancer in the Light of a Systemic Conception of Malignancy: A Research*, New York, Paul B. Hoeber, Inc., 1931.

nephrene. They stated that the so-called nervous group of conditions seems without doubt to be associated with changes in the potassium-calcium ratio, so that some of the symptoms may be sought in the alteration of the salt balance. Groups of persons with high blood calcium levels include a number of persons with cutaneous disorders as well as those with peripheral vascular changes: scleroderma, Raynaud's disease and Buerger's disease. In comparing 10 markedly sympathicotonic persons and 10 markedly vagotonic persons, the former had higher calcium levels but lower potassium-calcium ratios; 4 patients had an associated or underlying change in the potassium-calcium ratio, and the group had a low potassium level.

Weinstein and Weiss<sup>86</sup> concluded that an increase in the potassium content, an increase in the cholesterol content, or a decrease in the calcium content of the circulating blood alone or in combination is not responsible for the increase in the arteriolar resistance of arterial hypertension. In contrast, Löwenstein<sup>87</sup> believed that the slight changes in the amount of calcium and potassium in the spinal fluid and blood exert an influence on the development of hypertension. Aub and his co-workers<sup>88</sup> concluded that the excretion of calcium by patients with exophthalmic goiter and by those with adenoma of a hyperfunctioning thyroid is increased markedly above the normal and that this increase (231 per cent) is far greater than the increase in the basal metabolic rate (55 per cent). Bergeim, Stewart and Hawk,<sup>89</sup> in cases of acromegaly, found a distinct retention of calcium, magnesium and phosphorus, which was not accompanied by corresponding changes in general metabolism. Waldorp<sup>90</sup> reported an increased basal metabolic rate and a low blood calcium content with pronounced vagotonia and eosinophilia in 4 cases of acromegaly. Root and his co-workers<sup>91</sup> pre-

86. Weinstein, A. A., and Weiss, S.: The Significance of the Potassium-Calcium Ratio and of the Inorganic Phosphorus and Cholesterol of the Blood Serum in Arterial Hypertension, *Arch. Int. Med.* **48**:478 (Sept.) 1931.

87. Löwenstein, W.: Der Einfluss von Kalium-Calcium auf die Blutdrucksteigerung. (Zugleich ein Beitrag zur Frage der Blutliquorschanke), *Ztschr. f. klin. Med.* **125**:267 (Sept. 23) 1933.

88. Aub, J. C.; Bauer, W.; Heath, C., and Ropes, M.: Studies of Calcium and Phosphorus Metabolism: III. The Effects of the Thyroid Hormone and Thyroid Disease, *J. Clin. Investigation* **7**:97, 1929.

89. Bergeim, O.; Stewart, F. I., and Hawk, P. B.: A Study of the Metabolism of Calcium, Magnesium, Sulphur, Phosphorus and Nitrogen in Acromegaly, *J. Exper. Med.* **20**:218 (Sept.) 1914.

90. Waldorp, C. P.: Rapports entre le métabolisme basal, la calcémie et l'excitabilité du système nerveux végétatif dans l'acromégalie, *Compt. rend. soc. de biol.* **94**:492 (Dec. 5) 1925.

91. Root, H. F.; White, P., and Marble, A.: Abnormalities of Calcium Deposition in Diabetes Mellitus, *Arch. Int. Med.* **53**:46 (Jan.) 1934.

sented data to show that various types of abnormalities of deposition of calcium are found in cases of diabetes mellitus. In 8 cases of ulcer, Steinitz<sup>92</sup> found no definite changes in the calcium-potassium ratio of the blood. However, Wolf<sup>93</sup> reported an increase in serum calcium in 39 cases of ulcer and 22 cases of functional disturbance.

Of important biologic and clinical significance are the symptoms that appear due to embryologic disturbances. This is especially true when the nervous (retina, eyeball and its contents) and cutaneous tissues are involved because of their similar origin from the ectoderm. Yakovlev and Guthrie<sup>94</sup> considered mental defect in cases of epilepsy associated with three congenital neurocutaneous syndromes as a result of defective integration of the nervous functions caused by the malformation of the primitive ectoderm. Of biologic importance is the concept of the skin as the periphery of the organism, the region in which the metabolic processes are going on. Müller and Petersen<sup>95</sup> stressed the importance of the splanchnoperipheral balance, in that stimulation of the one (parasympathetic status of the splanchnic area) is promptly followed by sympathetic orientation in the other area (skin).

In a review of the symptom complex of eczema, Stokes<sup>96</sup> stated that the influence of pituitary hormone and calcium is on the calcium metabolism, which is in some way involved in all dermatitis, for calcium is the physiologically sedative side of the metallic ion balance in the skin. In more specific studies, Klauder and Brown,<sup>97</sup> in 77 per cent of 18 rabbits, showed the relationship of decreased cutaneous irritability and an increased calcium content of the skin. However, Schoch<sup>98</sup> could not demonstrate any perceptible change in the irritability of the skin of dogs as a result of hypercalcemia caused by the administration of vio-

92. Steinitz, H.: Kalzium und Kalium im Blutserum bei Ulcus ventriculi et Duodeni, *Arch. f. Verdauungskr.* **38**:347, 1926.

93. Wolf, G.: Der Kalium-Calciumspiegel im Blutserum und die Reid-Huntsche Reaktion bei Ulcus ventriculi bzw. duodeni. Untersuchungen zur Frage der vegetativen Neurose, *Beitr. z. klin. Chir.* **155**:371, 1932.

94. Yakovlev, P. I., and Guthrie, R. H.: Congenital Ectodermoses (Neurocutaneous Syndromes) in Epileptic Patients, *Arch. Neurol. & Psychiat.* **26**:1145 (Dec.) 1931.

95. Müller, E., and Petersen, W. F.: Ueber das splanchnoperiphere Gleichgewicht der Gefässpermeabilität und seine klinische Bedeutung, *Klin. Wchnschr.* **5**:53, 1926.

96. Stokes, J. H.: The Complex of Eczema, *J. A. M. A.* **98**:1127 (April 2) 1932.

97. Klauder, J. V., and Brown, H. A.: Experimental Studies in Eczema: III. The Role of the Sympathetic Nervous System and the Calcium-Potassium Ratio in Altering Cutaneous Irritability in the Rabbit, *Arch. Dermat. & Syph.* **19**:52 (Jan.) 1929.

98. Schoch, A. G.: Influence of Viosterol Hypercalcemia on Skin Irritability of Dogs, *Arch. Dermat. & Syph.* **25**:835 (May) 1932.



sterol. In another study, Klauder and Brown<sup>99</sup> found that the calcium-potassium ratio in the skin of 4 of 5 rabbits was altered by the administration of autonomic drugs. The autonomic nervous system is concerned in altering cutaneous irritability in the rabbit, perhaps through a disturbance of the calcium-potassium ratio. Klauder and Brown<sup>100</sup> made 120 determinations of total serum potassium and total serum calcium and diffusible calcium in 107 patients with 24 different diseases of the skin. In the entire series the percentage of diffusible calcium in the total calcium in general ranged from 48 to 56 per cent. The lowest percentage, 38, was present in a patient with prurigo (Besnier). In patients with prurigo (Besnier) the diffusible calcium was decreased more than the total serum calcium; hence the potassium-diffusible calcium ratio was higher in a greater number of patients than the total calcium ratio. Patients with prurigo (Besnier) have many symptoms in common with those persons who suffer from allergic states and from vagotonia. Burgess,<sup>101</sup> from studies on the precipitable calcium and the total calcium of the serum in clinical cases, confirmed the contention of Klauder and Brown. Schwartz and Levin<sup>102</sup> and Percival and Stewart<sup>103</sup> did not find any positive relationship between the calcium content of the blood and the various dermatoses.

Of contrasting interest are the stability, reversal of irritability to a manifestation of immobility and hardness of structures of the skin, dependent on the degrees of calcification, in cases of scleroderma, calcinosis, dermatomyositis and myositis fibrosa. Sannicandro<sup>104</sup> found increased calcium in the tissues in 3 patients suffering from scleroderma and sclerodactylia without a satisfactory explanation for this increased calcium content. Underhill, Honeij and Bogert,<sup>105</sup> showed

99. Klauder, J. V., and Brown, H. A.: Experimental Studies in Eczema: II. Correlation of the Chemistry with the Irritability of the Skin of Animals Under Normal and Under Experimentally Induced Conditions, *Arch. Dermat. & Syph.* **15**:1 (Jan.) 1927.

100. Klauder, J. V., and Brown, H. A.: Experimental Studies in Eczema: V. Studies of the Potassium, Total and Diffusible Calcium Ratios in Blood of Patients with Diseases of the Skin, *Arch. Dermat. & Syph.* **22**:877 (Nov.) 1930.

101. Burgess, N.: Studies of Calcium Metabolism in Certain Diseases of the Skin, *Brit. J. Dermat. & Syph.* **40**:279 (July) 1928.

102. Schwartz, H. J., and Levin, O. L.: The Calcium Content of the Blood in Various Diseases of the Skin: Based on an Analysis of 300 Cases, *Arch. Dermat. & Syph.* **10**:544 (Nov.) 1924.

103. Percival, G. H., and Stewart, C. P.: The Calcium Content of the Blood-Serum in Skin Diseases, *Brit. J. Dermat.* **39**:144, 1927.

104. Sannicandro, G.: Calcium Metabolism in Scleroderma, *Arch. ital. di dermat., sif.* **4**:427 (June) 1929.

105. Underhill, F. P.; Honeij, J. A., and Bogert, L. J.: Studies on Calcium and Magnesium Metabolism in Disease: I. Calcium and Magnesium Metabolism in Leprosy, *J. Exper. Med.* **32**:41, 1920.

that in 2 cases of leprosy there was a definite retention of calcium. Ballif and Gherscovici<sup>106</sup> found blood calcium levels above normal (from 10.5 to 13.5 mg.) in 10 patients with severe pellagra. Turner<sup>107</sup> reported that in 42 pellagrins the serum calcium levels were considerably higher than the calculated values, and these abnormalities seemed to be related to disturbances of the nervous system.

Kirby<sup>108</sup> stated that the calcium in the aqueous humor represents the ionized and nonionized diffusible fraction from the total calcium of the blood serum. Calcium is greatly increased in the lens in cases of senile cataract. However, when serum calcium was investigated by him in such cases no variations were found. Cantarow<sup>30</sup> mentioned cataract, defects of the dental enamel, thinning and brittleness of the hair, brittleness and loss of nails and puffiness of the skin as trophic disturbances in cases of tetany. The suggestion is made by Walker<sup>109</sup> that progressive myopia may be a symptom of calcium deficiency. Kopetzky<sup>110</sup> reported that of 63 patients with progressive deafness, 100 per cent showed a disturbed calcium metabolism, and 84 per cent had a decreased blood calcium. Davenport and his co-workers<sup>111</sup> suggested that the gene of the X-chromosome is probably responsible for the abnormal calcium metabolism which many authors have found in cases of otosclerosis. Aub and Mirvish<sup>112</sup> were unable to satisfy themselves that sufferers from otosclerosis had low serum calcium values.

In 4 of 20 cases of rhinoscleroma, Wiraboff and Terain<sup>113</sup> found an increase in the blood serum calcium to above 12.9 mg. No relationship between the potassium and the calcium of the blood serum and the status of the vegetative nervous system could be demonstrated. Nelken,<sup>114</sup> in

106. Ballif, L., and Gherscovici, I.: La réserve alcaline et la calcémie dans la pellagre, *Compt. rend. Soc. de biol.* **98**:393, 1928.

107. Turner, R. H.: The Pathologic Physiology of Pellagra: III. The Serum Calcium and Phosphorus, with Especial Reference to Nervous Symptoms, *J. Clin. Investigation* **10**:87 (April) 1931.

108. Kirby, Daniel B.: Calcium in Relation to Cataract: I. In Vitro, *Arch. Ophth.* **5**:856 (June) 1931; II. In Vivo, *ibid.* **5**:868, 1931.

109. Walker, J. P. S.: Progressive Myopia: A Suggestion Explaining Its Causation and for Its Treatment, *Brit. J. Ophth.* **16**:48 (Aug.) 1932.

110. Kopetzky, S. J.: The Nature of Progressive Deafness: Further Studies, *Arch. Otolaryng.* **5**:404 (May) 1927.

111. Davenport, C. B.; Milles, B. L., and Frink, L. B.: The Genetic Factor in Otosclerosis, *Arch. Otolaryng.* **17**:135 (Feb.); 340 (March); 503 (April) 1933.

112. Aub, J. C.: Calcium and Phosphorus Metabolism, Harvey Lectures, Baltimore, Williams & Wilkins Company, 1930, p. 151.

113. Wiraboff, A. W., and Terain, S. A.: Zur Frage über den Tonus des vegetativen Nervensystems und über den Inhalt von Ca und K im Blutserum der Kranken mit atrophischem Schnupfen, Ozäna und Sklerom, *Ztschr. f. Laryng., Rhin., Otol.* **22**:116, 1932.

114. Nelken, A.: Ueber Veränderungen im Liquor bei oto-rhinogenen Erkrankungen, *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **133**:136, 1932.

patients with diseases of the ear, nose and throat, found constant spinal fluid calcium values between 4 and 5 mg.

As the functions of the vegetative nervous system and the electrolytes are important for the body in general, their relationship to the general metabolism of females has been investigated. The increase in galvanic irritability of the nerves in the later stages of normal pregnancy has been attributed to the increased fixation of calcium (diminution of ionized calcium in the tissues and dispersion of potassium) by Spiegler and Schol.<sup>115</sup> Spiegler and Stern<sup>116</sup> expressed the belief that there is a relationship between the galvanic irritability of the nerves and the changes in the electro-ultrafiltrate of the blood serum calcium partition. In toxic pregnancies the decreased galvanic irritability was explained by Spiegler<sup>117</sup> on the basis of increased calcium dispersion (increase of ionized calcium in the tissues) after his studies of the calcium partitions in the ultrafiltrate and electro-ultrafiltrate.

In contrast to this, Cantarow, Montgomery and Bolton<sup>118</sup> concluded that the toxemias of pregnancy are characterized by a marked decrease in the ratio of diffusible to nondiffusible calcium, due in most instances to an increase in the nondiffusible fraction. It is of interest that Van Dyke, Bailey and Bucy<sup>119</sup> suggested that the oxytocic substance of the spinal fluid appears to be calcium. Dragstedt and his co-workers<sup>120</sup> showed that the sudden onset and uniform severity of tetany in parathyroidectomized pregnant animals and the recurrence of tetany in partially parathyroidectomized dogs during estrus, pregnancy and lactation are significant facts. Watchorn and McCance<sup>23</sup> demonstrated in 12 pregnant patients that a larger amount of magnesium and calcium is ultrafiltrable in pregnancy than in normal conditions. Sjollemma<sup>121</sup> considered the lowering of the calcium content to 5 or 7

115. Spiegler, R., and Schol, W.: Die galvanische Nerven-Muskel-Erregbarkeit in der Schwangerschaft und bei Toxikosen, *Arch. f. Gynäk.* **141**:651, 1930.

116. Spiegler, R., and Stern, K.: Die Bedeutung der Zustandsformen des Kalkes und ihre Beeinflussung durch das Parathyroidea-Hormon, *Klin. Wchnschr.* **38**:1580 (Sept. 17) 1932.

117. Spiegler, R.: Die Zustandsform von Kalium und Calcium in der Gestation und ihre klinische Bedeutung, *Arch. f. Gynäk.* **145**:423, 1931.

118. Cantarow, A.; Montgomery, T. L., and Bolton, W. W.: The Calcium Partition in Pregnancy, Parturition and the Toxemias, *Arch. Surg., Gynec. & Obst.* **51**:469, 1930.

119. Van Dyke, H. B.; Bailey, P., and Bucy, P. C.: The Oxytocic Substance of Cerebrospinal Fluid, *J. Pharmacol. & Exper. Therap.* **36**:595 (Aug.) 1929.

120. Dragstedt, L. R.; Sudan, A. C., and Phillips, K.: Studies on the Pathogenesis of Tetany: IV. The Tetany of Oestrus, Pregnancy and Lactation, *Am. J. Physiol.* **69**:477, 1924.

121. Sjollemma, B.: Ueber die Bedeutung der Elektrolytconstellation für den Organismus: Die Biochemie der Gebärpause von Kuehen, *Biochem. Ztschr.* **200**:300, 1928.

mg. (normal, from 10 to 11 mg.) and probably also the decrease of inorganic phosphates as the cause of the paralytic state and other functional disturbances in the birth paresis of cows. Schultze<sup>122</sup> found that when there is a deficiency in the stimulation of the corpus luteum there are overstimulation and predominance of vagus tone, which shows a definite relationship between ovarian function and the potassium-calcium concentration in the blood serum. Mirvish and Bosman<sup>123</sup> reported that extracts of bovine ovaries injected into rabbits and human beings produced a characteristic decrease in the blood calcium content. These results could not be confirmed by Dixon.<sup>124</sup> Allen and Goldthorpe<sup>125</sup> believed that the normal menstrual period does not affect the blood calcium level, whereas Heyn and Haase<sup>126</sup> found a slight sinking of the blood calcium. Okey and her co-workers<sup>127</sup> concluded that while the changes in concentration of serum calcium at any phase of the monthly cycle are not outstanding, there is some tendency to frequency of low values for calcium a few days previous to the onset of menstruation and to frequency of higher values from the eighth to the fifteenth day following the onset of menstrual bleeding. Boynton and Greisheimer<sup>128</sup> concluded that the mean range of serum calcium in 10 women with dysmenorrhea, while lower than that found in a group of women with normal menstrual periods, was not significantly lower.

#### NEUROPSYCHIATRIC DISORDERS

Corlette,<sup>129</sup> in a study of certain diseases of animals and man, reviewed the subject theoretically. He mentioned that a deficiency of

122. Schultze, G. K. F.: Ovarialtätigkeit, Kalium-Calciumgehalt des Blutserums und vegetatives System, *Arch. f. Gynäk.* **126**:35, 1925.

123. Mirvish, L., and Bosman, L. P.: The Influence of the Internal Secretions of the Ovary on the Calcium Blood Level and on Calcium Metabolism, *Quart. J. Exper. Physiol.* **18**:11, 1927.

124. Dixon, T. F.: The Influence of Ovarian and Pituitary Hormones on Calcium Metabolism, *Biochem. J.* **27**:410, 1933.

125. Allen, E., and Goldthorpe, H. C.: A Comparison of Blood Calcium Levels Between and During Menstrual Periods, *Am. J. Obst. & Gynec.* **17**:789 (June) 1929.

126. Heyn, A., and Haase, K.: Ueber die Beziehungen der Ovarialfunktion zum Kalkgehalt des Blutserums, *Arch. f. Gynäk.* **126**:646, 1925.

127. Okey, R.; Stewart, J. M., and Greenwood, M. L.: Studies of the Metabolism of Women: IV. The Calcium and Inorganic Phosphorus in the Blood of Normal Women at the Various Stages of the Monthly Cycle, *J. Biol. Chem.* **87**:91, 1930.

128. Boynton, R. E., and Greisheimer, E. M.: Serum Calcium in Relation to Menstruation in Cases with Dysmenorrhea, *Proc. Soc. Exper. Biol. & Med.* **29**: 1115 (June) 1932.

129. Corlette, C. E.: Observations on Calcium Deficiency as a Cause of Certain Diseases of Animals and Man, *M. J. Australia* **1**: 198 (Feb. 18) 1928.

calcium and / or phosphorus can cause nervous disorders closely resembling those produced by a deficiency of vitamin B. When this deficiency is implicated, some of the nervous symptoms are: polyphagia, earth eating, bone chewing, coprophagia, ergotism, "lathyrism—" and the *stijfsiekte* and *lamziek* of South African cattle. Sjollema and Seekles,<sup>130</sup> in the study of a bovine disease, grass tetany, which is characterized by restlessness, twitching of the muscles and unsteady gait, followed by tonic-clonic convulsions and involvement of the limbs, found a mean blood serum calcium of 6.65 mg. (normal mean, 9.35 mg.). The calcium-magnesium ratio in the blood serum in animals with grass tetany reached 14.6 mg. as contrasted with the normal mean of 5.6 mg.

The relationship of calcium metabolism and parathyroprival tetany needs no further mention (MacCallum and Voegtlin).<sup>44</sup> Halverson and Bergeim<sup>131</sup> found that the calcium content of the spinal fluid in 20 patients, most of whom had neurologic disorders, remained constant at about 5 mg. Repeated drainage did not appear to affect the composition of the fluid in respect to calcium. Critchley and O'Flynn,<sup>132</sup> in 1924, found an average of 6.22 mg. of calcium in the spinal fluid in 115 cases and concluded that an examination of the calcium of the spinal fluid offered no assistance in the diagnosis of neurologic disorders.

Cantarow,<sup>133</sup> in 68 essentially normal persons, found that the spinal fluid calcium varied from 4.52 to 5.5 mg. In studies on patients with inflammatory diseases of the meninges and brain, atopic disorders and syphilis and in many with pulmonary tuberculosis, he found considerable variation well above the high limit of normal.

Warner<sup>134</sup> found changes in the calcium in the spinal fluid of patients with chorea, the value rising as the disease content became less severe and the patient entered the state of recovery. In 18 cases of severe chorea the average calcium content of the spinal fluid was 4.64 mg.; in 7 cases of severe chorea with recovery, the spinal fluid calcium was 5.18 mg. within six months of the recovery (methods of Bainbridge and Trevan). Warner concluded that in cases of severe chorea the value is always subnormal and rises 12.8 per cent when recovery occurs.

130. Sjollema, B., and Seekles, L.: Ueber Störungen des mineralen Regulationsmechanismus bei Krankheiten des Rindes. (Ein Beitrag zur Tetaniefrage), *Biochem. Ztschr.* **229**:358, 1930.

131. Halverson, J. O., and Bergeim, O.: The Calcium Content of Cerebrospinal Fluid, Particularly in Tabes Dorsalis, *J. Biol. Chem.* **29**:337 (March) 1917.

132. Critchley, M., and O'Flynn, E.: The Calcium Content of the Cerebrospinal Fluid, *Brain* **47**:337, 1924.

133. Cantarow, A.: Calcium Studies: IV. The Calcium Content of Cerebrospinal Fluid, *Arch. Int. Med.* **44**:667 (Nov.) 1929.

134. Warner, E. C.: A Study of Calcium Metabolism in the Acute Stages of Chorea in Children, *Lancet* **1**:339 (Feb. 15) 1930.

In view of the very small changes, it seems that these were not of real significance; furthermore, the calcium content of the blood serum was not determined simultaneously. Neustaedter and his co-workers<sup>135</sup> in 6 cases of chorea reported an average calcium content in the spinal fluid of 4 mg. Neale and Esslemont,<sup>136</sup> in children under 12 who had neither convulsions nor evidences of meningeal involvement, found the calcium content of the spinal fluid to vary from 5 to 6.5 mg. In cases of tuberculous meningitis without convulsions the average was 6.3 mg., and in cases of tuberculous meningitis with convulsions 6.8 mg. It may be that the increase in the calcium content was related to an increase in the protein content of the spinal fluid; unfortunately, this was not given by the authors.

Nourse and his co-workers<sup>137</sup> in 17 cases of spasmophilia found that the blood calcium was 6.6 mg. and the spinal fluid calcium 4.6 mg.; following recovery the blood calcium was 9.9 mg. and the spinal fluid calcium 4.86 mg. The average calcium content of the spinal fluid was practically the same in the two groups. Ingvar<sup>138</sup> reported a decrease of the calcium in the spinal fluid in 9 patients with spasmophilia (4.28 mg.) in contrast to 5 mg. in persons without spasmophilia. However, he did not determine the blood calcium and the spinal fluid calcium simultaneously. Wilcox and his co-workers<sup>139</sup> in 5 children with tetany found a slightly lower average for both the blood serum calcium and the spinal fluid calcium. Herbert<sup>12</sup> made the suggestion that the fact that the spinal fluid calcium is not significantly lowered in cases of tetany while the diffusible serum calcium is lowered may explain why the nervous symptoms in cases of tetany are peripheral and not central.

Osnato and his co-workers,<sup>140</sup> in 1927, found a constant ratio of spinal fluid calcium to blood serum calcium in 130 cases of idiopathic epilepsy, the average being 51 per cent with extremes of 48 and 56

135. Neustaedter, M.; Hala, W. W., and Tolstouchow, A.: Relation of Calcium Content of Spinal Fluid to Postlumbar Puncture Headache, *J. A. M. A.* **85**:347 (Aug. 1) 1925.

136. Neale, A. V., and Esslemont, M.: Observations on the Chloride, Sugar and Calcium Contents of the Cerebrospinal Fluid in Children, *Arch. Dis. Childhood* **3**:243 (Oct.) 1928.

137. Nourse, J. D.; Smith, D. M., and Hartman, J. I.: Inorganic Constituents of Blood and Cerebrospinal Fluid, *Am. J. Dis. Child.* **30**:210 (Aug.) 1925.

138. Ingvar, S.: Contribution to the Question of the Percentage of Calcium and Phosphorus in the Cerebrospinal Fluid in Spasmophilia, *Acta Paediat.* **8**:198, 1928.

139. Wilcox, H. B.; Lyttle, J. D., and Hearn, J. E.: The Chemical Composition of the Spinal Fluid: Diagnostic Value, *Am. J. Dis. Child.* **30**:513 (Oct.) 1925.

140. Osnato, M.; Killian, J. A.; Garcia, T., and Mattice, M. R.: Comparative Chemical Studies of the Blood and Spinal Fluid in Epilepsy, *Brain* **50**:581, 1927.



per cent. From their work it was evident that no analogy exists between the etiology of convulsions in cases of tetany or nephritis and the etiology of convulsions in cases of epilepsy so far as calcium metabolism is concerned. Lennox and Allen,<sup>141</sup> in studying the ratio of blood serum calcium to spinal fluid calcium, found the average ratio for 77 epileptic patients to be 48 per cent and the average ratio for 51 nonepileptic patients, 51 per cent. The deviation from the normal in the average measurements of calcium in the group reported was not enough to attract attention. They concluded that there were slight abnormalities in endocrine function, in the ion equilibrium or in the circulation of the patients. The high ratio of spinal fluid calcium to blood calcium in 11 of 86 cases and the fact that in no case was there a low ratio suggested to Katzenelbogen<sup>142</sup> that in epilepsy there is a tendency to an increased permeability of the meninges to calcium. Patterson<sup>143</sup> found 80 per cent of 100 epileptic patients to have from 10 to 12.9 mg. of calcium in the blood. He inferred from this that the blood calcium in epileptic persons is usually normal. Coombs and Searle<sup>144</sup> found a steady increase in the calcium content of the blood serum of cats as the number of occlusions of the arteries of the head increased. Coombs and his co-workers<sup>145</sup> reported the important clinical fact that the effect of previous administration of bromides on control animals is to reduce the magnitude of the changes in calcium and phosphorus after convulsants have been administered. They concluded that it is highly probable that the concentration of potassium, of calcium and of phosphates rise during a convulsion and that these changes are a result, and not the cause, of the convulsion.

Neustaedter and his co-workers<sup>135</sup> found no significant relationship between headache following lumbar puncture and the calcium content of the spinal fluid. Peritz<sup>146</sup> concluded that migraine is essentially

141. Lennox, W. G., and Allen, M. B.: The Calcium Content of the Blood and of the Spinal Fluid, *Arch. Neurol. & Psychiat.* **24**:1199 (Dec.) 1930.

142. Katzenelbogen, S.: The Distribution of Calcium Between Blood and Fluid and the Carbon Dioxide Content of the Blood in Epilepsy: The Relation Between Epilepsy and Tetany, *J. Nerv. & Ment. Dis.* **74**:636 (Nov.) 1931.

143. Patterson, H. A.: Some Observations on Blood-Calcium Content in Epilepsy: Epilepsy and the Convulsive State, Baltimore, Williams & Wilkins Company, 1931.

144. Coombs, H. C., and Searle, D. S.: Calcium and Phosphorus of the Blood During Cerebral Anemia, *Am. J. Physiol.* **105**:23, 1933.

145. Coombs, H. C.; Searle, D. S., and Pike, F. H.: The Changes in the Concentration of Inorganic Calcium and Phosphorus During Convulsions of Experimental Origin, in Cats Before and After Thyroparathyroidectomy, With and Without Bromide Therapy, *Am. J. Psychiat.* **13**:761 (Jan.) 1934.

146. Peritz, G.: Zur Pathologie und Therapie der Kopfschmerzen, *Med. Klin.* **23**:1169, 1927.

an angiospastic disturbance, characterized by relatively high potassium and calcium values in the blood. Hartung<sup>147</sup> in 10 cases of migraine found that the blood calcium was 10.4 and 10.3 mg. between and during attacks, respectively, there being no relation between the occurrence of migraine and the calcium content of the blood. Norman<sup>148</sup> proposed the term "migraine-tetanic syndrome" because hypoparathyroidism was thought to be present; however, the evidence is unconvincing.

Wagner,<sup>149</sup> in a typical case of narcolepsy with both cataplectic and narcoleptic attacks, gave an intravenous injection of 10 cc. of a 10 per cent solution of calcium chloride with urea. The blood calcium was 11 mg. during the normal state, but five minutes after injection it was still 16.5 mg. A cataplectic seizure was induced, and the author considered this in possible causal relationship to the injection of calcium. The author's comments are speculative, and more specific data of controlled nature are necessary before one can consider seriously the suggestions offered. Serejski and Frumkin<sup>150</sup> reported a high blood serum calcium (De Waard method) of 13.5 mg. before their patient experienced a narcoleptic seizure and 11 mg. after the seizure. Unfortunately these findings were not repeated, and more exact data are lacking. In 11 cases of narcolepsy observed at the Mayo Clinic, Daniels<sup>151</sup> found that the blood serum calcium ranged from 8.8 to 10.6 mg., the average being 9.9 mg. In a case of periodic family paralysis, Neustaedter<sup>152</sup> reported a high blood calcium of 20 mg. (with no mention of this being repeated) eleven days after the attack.

Pemberton<sup>153</sup> and Diller and Rosenbloom<sup>154</sup> reported a marked loss of calcium by the tissues in the cases of myasthenia gravis. Rosenbloom and Cohoe<sup>155</sup> expressed the opinion that the loss of calcium may play

147. Hartung, E. F.: Endocrine Factors in Migraine, *M. J. & Rec.* **132**:497, 1930.

148. Norman, G. F.: Hypocalcemia: Its Relationship to Migraine, *J. A. M. A.* **102**:529 (Feb. 17) 1934.

149. Wagner, C. P.: Comment on the Mechanism of Narcolepsy with Case Reports, *J. Nerv. & Ment. Dis.* **72**:405 (Oct.) 1930.

150. Serejski, M., and Frumkin, I.: Narkolepsie und Epilepsie, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **123**:233, 1930.

151. Daniels, L. E.: Narcolepsy, *Medicine* **13**:1 (Feb.) 1934.

152. Neustaedter, M.: A Case of Periodic Family Paralysis, *New York State J. Med.* **22**:65 (Feb.) 1922.

153. Pemberton, R.: The Metabolism of Myasthenia Gravis with a Suggestion Regarding Treatment, *Am. J. M. Sc.* **139**:816 (June) 1910.

154. Diller, T., and Rosenbloom, J.: Metabolism Studies in a Case of Myasthenia Gravis, *Am. J. M. Sc.* **148**:65 (July) 1914.

155. Rosenbloom, J., and Cohoe, B. A.: Clinical and Metabolism Studies in a Case of Myotonia Congenita: Thomsen's Disease, *Arch. Int. Med.* **14**:263 (Aug.) 1914.

a part in the production of the symptoms of myotonia congenita. In 8 cases of myotonic atrophy Weill<sup>156</sup> found that the total blood calcium was normal while the ultrafiltrable portion was diminished. Wills<sup>157</sup> found that there was little variation from the normal blood calcium in 30 hypotonic children, but the variation was greater than in a control series. In the syndrome of hyperparathyroidism described by Barr and Bulger,<sup>158</sup> muscular hypotonicity and diminished irritability of the nerves may occur with hypercalcemia. Warner and Hampson<sup>159</sup> reported low calcium values in the spinal fluid in 6 of 7 cases of progressive muscular atrophy and in 3 cases of Werdnig-Hoffmann's muscular atrophy. In 3 of 4 cases of pseudohypertrophic dystrophy the spinal fluid calcium values were normal. In 2 cases of Dupuytren's contracture Leriche and Jung<sup>160</sup> found the blood calcium lower than normal. Choroško and Markovnikova<sup>161</sup> found normal blood serum calcium values in 22 laborers with a lumbo-ischial syndrome. In chronic encephalitis with disturbances of the vegetative nervous system, Tschalissov<sup>162</sup> reported that the serum calcium was elevated in most instances. There was no correlation between the clinical status, constitution or vegetative tonus and the calcium content. Of 18 cases of postencephalitic parkinsonism, Hühnerfeld<sup>163</sup> reported only 4 in which the calcium values of both the blood serum and the spinal fluid calcium were within normal limits. Cristini<sup>164</sup> failed to confirm the findings of Cornil and Verain,<sup>165</sup> who

156. Weill, J.: Calcium total et calcium ultrafiltrable du sérum en pathologie, *Compt. rend. Soc. de biol.* **109**:927, 1932.

157. Wills, L.: Blood Calcium and Inorganic Phosphates in Children with Marked Lack of Muscle Tone, *Brit. M. J.* **1**:302, 1925.

158. Barr, D. P., and Bulger, H. A.: The Clinical Syndrome of Hyperparathyroidism, *Am. J. M. Sc.* **179**:449 (April) 1930.

159. Warner, E. C., and Hampson, A. C.: Investigation and Treatment of Certain Cases of Disease and Nerves, *Proc. Roy. Soc. Med.* **25**:1213 (Feb. 9) 1932.

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163. Hühnerfeld, J.: Ueber den Zucker- und Calciumspiegel, die Blutsenkung und das Hämogramm beim postenzephalitischen Parkinsonismus, *Monatschr. f. Psychiat. u. Neurol.* **77**:348, 1930.

164. Cristini, R.: Il disequilibrio calcio-potassio nelle sindromi parkinsoniane, *Riv. di neurol.* **5**:113, 1932.

165. Cornil, L., and Verain, M.: Les variations comparatives de la calcémie du côté sain et du côté atteint dans les hémisyndromes parkinsoniens, *Compt. rend. Soc. de biol.* **97**:1293, 1927.

reported variations in blood calcium in the involved side of the body in 8 cases of unilateral postencephalitic parkinsonism. Neidung and Kolik<sup>166</sup> reported a tendency toward hypercalcemia in cases of hemiplegia, especially when the lesions occurred bilaterally in the brain. In 15 cases of multiple sclerosis, Merritt<sup>167</sup> reported that the calcium content of the spinal fluid was between 47 and 55 per cent of that of the blood, practically within normal limits.

Michaels and Searle,<sup>2</sup> in a clinical laboratory study of 80 patients with 18 different neuropsychiatric disorders, reported no significant abnormal findings in the calcium of the spinal fluid, blood serum or an ultrafiltrate of the serum or in the ratios of these quantities to each other. They found no correlation between the calcium content and more specific variables, such as "nervous instability," somatic and neurologic deviations, vasomotor instability, retinal endarteritis, constitutional type (asthenic, athletic and pyknic), weight-height index, sex, age, blood pressure and intelligence quotient. As attention at the time was called to some of the pertinent psychiatric literature, only the more recent and important contributions will be mentioned. Schrijver,<sup>168</sup> in a review of cases of manic-depressive psychosis, concluded that the blood calcium values are within the normal range and that there is a greater inconstancy of the calcium and potassium values in such cases than in normal states. In depressive states there is a tendency to a relative lowering of the calcium content and an elevation of the potassium content; the reverse takes place in manic states. Walther and Gordonoff<sup>169</sup> found a more labile blood serum calcium in persons with the catatonic phase of schizophrenia than in normal persons.

Looney<sup>170</sup> found a slight decrease in the blood calcium, 9.1 mg., in a series of 11 patients with dementia praecox, catatonic state, showing various degrees of rigidity. By injections of parathyroid hormone the calcium content of the serum was increased by from 0.4 to 14 mg. This figure was maintained for several days, and there was a decrease in the muscular rigidity, so that whereas before the injections it was impossible

166. Neidung, M., and Kolik, M.: Kalium- und Calciumgehalt des Blutes und der cerebrospinalen Flüssigkeit bei Nervenkranken, *Monatschr. f. Psychiat. u. Neurol.* **66**:197, 1927.

167. Merritt, H. H.: The Cerebrospinal Fluid in Multiple Sclerosis, *Brain* **57**:56 (March) 1934.

168. Schrijver, D.: Literaturübersicht über die pathophysiologische Erforschung der manisch-depressive Psychose (1922-1932), *Psychiat. en neurol. bl.* **37**: 605 (Sept.-Dec.) 1933.

169. Walther, F., and Gordonoff, J.: Ueber das vegetative Nervensystem und seine Beeinflussung durch pharmakologische Gifte bei Katatonikern, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **142**:616, 1932.

170. Looney, J. M.: The Control of the Muscular Rigidity of Catatonic Praecox Patients by Parathyroid Hormone, *J. Biol. Chem.* **67**:xxxvii, 1926.

to open the patient's hand afterward almost complete extension was obtained. In an attempt to verify these findings Bowman<sup>171</sup> concluded that there was no clear evidence of any relationship between the calcium content of the blood and the parathyroid activity on the one hand and catatonic states on the other. Manifestations of constitutional calcium starvation are principally observed in the endocrine, digestive and developmental glands according to Stheeman.<sup>172</sup> A familial condition characterized by cataract, a retardation in somatic development, the presence of neuropsychic disturbance and hypocalcemia was described by Marinesco and his co-workers.<sup>173</sup> Stearns<sup>174</sup> found normal blood serum calcium and a normal potassium-calcium ratio in a group of stutterers. Jaensch<sup>175</sup> stated that there is a variability of the eidetic image in relation to calcium metabolism and that the eidetic disposition in the T type is weakened by calcium treatment.

#### COMMENT AND CONCLUSIONS

From the vastness of the preceding material, what has impressed me as significant has been the absence of definite, specific and constant results and the presence of indefinite, more general and variable findings. Is this due to the lack of an exact technic, or are there more complicated units and interrelated variables which at present are difficult to grapple with? As the seemingly simple relationships of calcium at the lower levels (physicochemical) of the body have as yet not been established, how is it possible to speculate with any degree of assuredness as to what occurs in the higher levels of the personality?

Hoff<sup>176</sup> has demonstrated how a change in one system calls forth a change in the other; e. g., with stimulation of the sympathetic nervous system there is a series of dependent changes resulting in a tendency toward an increase in calcium, acidosis, myelogenesis and an increase in temperature, basal metabolism and sugar content. On the other hand,

171. Bowman, K. M.: Parathyroid Therapy in Schizophrenia, *J. Nerv. & Ment. Dis.* **70**:353 (Oct.) 1929.

172. Stheeman, H. A.: *Adynamie und Blutkalkspiegel. (Die calciprive Konstitution), Jahrb. f. Kinderh.* **94**:27, 1921.

173. Marinesco, G.; Draganesco, S., and Vasiliu, D.: Nouvelle maladie familiale, caractérisée par une cataracte congénitale et un arrêt du développement somato-neuro-psychique, *Encéphale* **26**:97 (Feb.) 1931.

174. Stearns, Genevieve: Personal communication, department of pediatrics, State University of Iowa.

175. Jaensch, E. R.: *Eidetic Imagery and Typological Methods of Investigation*, London, Kegan Paul, Trench, Trubner & Co., Ltd., 1930.

176. Hoff, F.: Die Beziehungen zwischen Blutbild, Säurebasenhaushalt und Kalium-Kalzium-Haushalt. Beitrag zur Frage der vegetativen Regulation des Blutes, *Folia haemat.* **42**:281, 1930.

with stimulation of the vagus nerve there ensues a tendency to an increase in potassium, alkalosis, an increase in lymphocytes and a decrease in temperature, basal metabolism and sugar content. From clinical experiences it is known that it is almost impossible to determine the exact status of the vegetative nervous system. With the realization that there are so many relative and dependent situations in the lower levels, it seems indicated to search for the constants there and then build on this as a solid framework. All these factors are biologically related, and only theoretically and experimentally can they be isolated.

It has been my aim to review the knowledge concerning calcium chiefly in respect to neuropsychiatric considerations from the point of view of the various levels, of the interrelationship of these levels and finally of the total personality. The complexity and the difficulty of conceiving the problem in fragments, it is hoped, will appear evident. The relatively simple situation of cellular permeability cannot be separated and isolated from the electrolytic milieu, the influence of the vegetative nervous system and the endocrine glands and the emotional states arising from human conflict.

#### CONCLUSIONS

1. Deficiency of calcium definitely plays a rôle in neuromuscular activity. The specific relationship of calcium metabolism to parathyroprival tetany and to the state of hyperparathyroidism has been established.

2. The calcium of the spinal fluid probably represents the diffusible portion of the blood serum calcium when this is at a normal stable level but not necessarily when there are marked fluctuations in the blood serum calcium.

3. The theory that the action of calcium is analogous to that of the sympathetic part of the vegetative nervous system and that the action of potassium is analogous to that of the vagus nerve, although suggestive, has not been incontrovertibly proved.

4. The injection of calcium preparations into the hypothalamic region in animals seems to have a positive effect in producing somnolence. The question of the central regulation of the electrolytic balance by the hypothalamus has at yet not been definitely proved.

5. There is a lability of the blood serum calcium and its partitions in certain physiologic states (menstruation and the later stages of pregnancy) and in some clinical conditions (imbalance of the vegetative nervous system).

6. There is a tendency for cutaneous irritability to vary inversely with the calcium content of the skin.



7. There is no significant evidence to show a relationship between calcium deficiency and epilepsy, narcolepsy, cataplexy and migraine. Of the neurologic diseases, postencephalitic parkinsonism is the only one which shows a slight lability of the blood calcium.

8. There is a tendency for the blood serum calcium and its partitions to manifest a greater lability in the presence of mental disease (schizophrenia, manic-depressive psychosis and severe emotional states) than under normal conditions.

9. The following suggestions appear worth while:

(a) The determination and establishment of all those lower level variables that influence the electrolytic salts and bear a definite relationship to them.

(b) A realization of the intricate interdependence of the various levels of the personality: the electrolytic milieu, the vegetative nervous system, the endocrine glands, the central nervous system and the psyche.

(c) The avoidance of a comparison of such a fine element of the blood and spinal fluid as calcium with the complex entity of a disease, such as schizophrenia. There are too many unrelated and unknown links to justify any attempts at correlation. In the endeavor to study calcium metabolism in neuropsychiatric disorders it would be desirable to correlate the chemical data with simple, more closely related events, such as those clinical factors that may be influenced by calcium metabolism. Among these are clinical evidences of nervous irritability, e. g., the Chvostek sign, myotatic irritability and autonomic imbalance. The necessity of utilizing more definite and specific variables is important. The gross, crude, all-embracing diagnoses, such as schizophrenia, epilepsy, feeble-mindedness, etc., are loaded with an infinite number of variables, and it is imperative that one find those reducible variables that are related to the problem at hand. Thus it is easier to delimit and make use of the lower level concomitants of schizophrenia than to deal with the complex entity of schizophrenia itself. As a specific illustration, every clinician knows of the prevalence of the disturbances of the vegetative nervous system and of the psychomotor sphere in the catatonic forms of schizophrenia. These changes can be objectively defined and described with a certain amount of specificity, e. g., cyanosis of the extremities, vasomotor instability, excessive sweating, seborrhea of the face and rigidity of the musculature. This method of searching for specific, definite and measurable variables can probably be applied to all neuropsychiatric disorders.

JEAN MARTIN CHARCOT

1825-1893

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AND

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MONTREAL, CANADA

In the beginning of the nineteenth century there stood in the eastern outskirts of Paris, close by the Gare d'Orléans, a group of buildings which for many years functioned as a hostel for infirm and abandoned old women. Built in the reign of Louis XIII, it served its original purpose, that of an arsenal, for only a little over fifty years. This was sufficiently long, however, to ensure the perpetuation of the name, Salpêtrière, with which its early association with saltpeter, an essential ingredient of gunpowder, had invested it.

In 1656 it was converted by St. Vincent de Paul into an asylum where old women, abandoned prostitutes and the frankly insane were herded together in a motley, indiscriminate array of unwanted woman-kind. Later, the prostitutes were moved to other quarters, but for more than a century it remained a very ordinary asylum, with all the horrors and cruelties incidental to the management of the insane of that day.

By this time, the beginning of the nineteenth century, however, the flare of genius had already been attracted to the Salpêtrière, for the first great step in the emancipation of the insane had been taken by Pinel and Esquirol who, flaunting the advice of friends, boldly struck off the shackles which for centuries had held these unfortunates in the cruelest bondage. With this act a new and better day dawned for the mentally unfit.

By the middle of the century this relative freedom affected the entire population of almost 5,000 persons, of whom 3,000 suffered from epilepsy and the various neuroses, particularly hysteria, while over 1,000 were the victims of frank psychoses; but it appears that no attempt at segregation or classification had yet been made.

The freest intercommunication between hysterical, epileptic and psychotic patients was condoned, and one cannot wonder that this chaotic mêlée of abnormal humanity came to vie with the theaters and music halls in the entertainment of the pleasure-seeking youth of Paris.

In 1848, into this "pandemonium of infirmities," as he himself later dubbed it, came as intern under Piorry a young medical student who was destined to bring order out of its chaos, to unearth the hidden truths which even then he knew lay buried in this seething mass of distracted humanity and to march hand in hand with the Salpêtrière to the glories of scientific achievement. This young man was Jean Martin Charcot. To speak of the Salpêtrière is to think of Charcot. They remain inseparable.

Jean Martin Charcot was born in Paris on Nov. 25, 1825. His father, a professional carriage-builder, was at heart an artist—a bent which found expression in the designing and building of carriages renowned for their beauty rather than for their utility, and which lived afresh in the artistic aptitudes of his son, whose love and talent for art ranked second only to those for science.

Little is known of Charcot's early life, but it may be assumed that much of his strength of character and clearness of vision was a legacy from his father, who wisely selected from his four sons the youngest, Jean Martin, to follow a professional career, giving him the choice of medicine or painting. That he might have chosen the latter is, to the sons of Aesculapius, a disquieting thought. His premedical education was acquired at the Lycée Bonaparte, and it is noteworthy that he became proficient in at least three foreign languages—English, Italian and Dutch—in a period, too, which did not recognize the necessity of such attainments.

Charcot's undergraduate internship (1848-1852) was spent at the Salpêtrière, and there can be little doubt that even in these early years he foresaw the great possibilities which in later life were to unfold into accomplishment. In any case, after graduation in 1853 and after spending several years as chief of the clinic under Rayer, he returned to the Salpêtrière in 1862 where, in association with Vulpian, he took over the medical services, not to relinquish them until his death in 1893.

These earlier years, however, were not without their tribulation. The first real hurdle, which he cleared only on the second attempt, was the winning of the concours, a sort of competitive debate, entitling the successful candidate to teaching rights—*professeur agrégé*. Charcot, at no time an orator, was badly worsted at his first trial by competitors whose oratory far outdid their clinical knowledge. His second attempt, in 1860, opened equally badly, and had he not succeeded in maneuvering his opponents into a clinical discussion, in which he excelled, he would have failed again. The maneuver was signally successful. His argument was invincible. He had won his *agrégé*.

And so, in 1862, he entered on his life's work at the Salpêtrière where one of his first efforts was the establishment of a small pathologic laboratory, for which he was granted space in a dingy cupboard-

like room but for which he had to provide his own equipment. Thus, early in his career he learned to combine the pathologic approach with the clinical, so to evolve his famous anatomicoclinical method of study which, in later years, was to become the outstanding feature of his world-famous reputation as a teacher.

Although universally conceded a place among the world's great neurologists, Charcot occupied his earlier years in the study of general medicine, and his theses on gout and rheumatism, which he differentiated, on diseases of the heart, lungs, liver and kidneys and on the diseases of old age are lasting monuments to his great clinical and pathologic acumen. But Charcot's destiny could not be denied. To him this new domain was a mine of hidden neurologic wealth, awaiting only the sesame of the scientific explorer. What was more natural, and likewise more beneficent, than that he should bestow his great gifts on the study of diseases of the nervous system?

Among his immediate precursors in this field were men like Romberg, Bouillaud, Broca, Cruveilhier and Duchenne of Boulogne. Charcot held the last in the highest esteem and frequently referred to his work in warmest terms. In fact, the epochal works of Duchenne, a sadly retiring and timid man, found their public in great part through the pen and tongue of Charcot.

A cursory review of Charcot's original contributions to neurology not only impresses one with his great genius and enviable industry, but impels one to question, "What would neurology be today had fate decreed that Charcot should be a painter?" Roughly drawn lines arrange his work under four headings: (1) studies, clinical and pathologic, on abdominal and thoracic organs, especially in old age; (2) studies on organic disease of the nervous system, including original descriptions of disease entities; (3) studies on the psychoneuroses—hysteria, hypnotism and psychotherapy, and (4) studies on art as applied to the illustration of diseases of the nervous system.

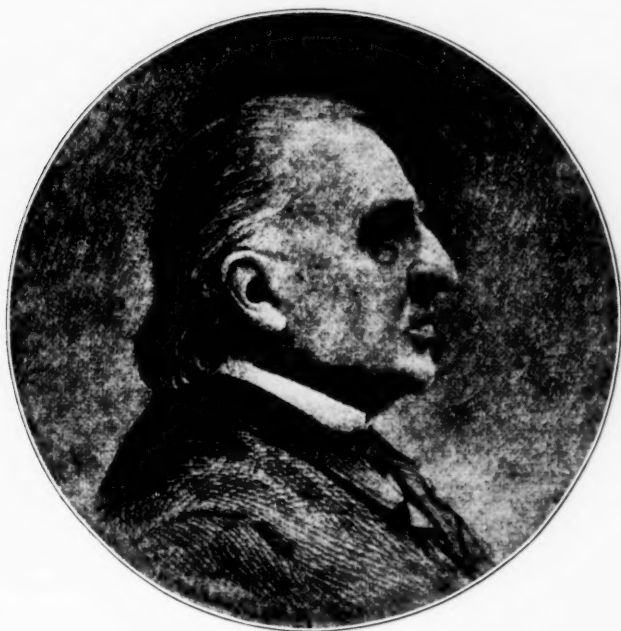
The first group embraces a number of exhaustive, clearly reasoned contributions which, in themselves, would ensure him a place among the great contributors of that day, but it is undoubtedly in the field of neurology that his best and most enduring work was done.

In 1864 he demonstrated, by autopsy, the relation between certain types of muscular atrophy and poliomyelitis, which disease he showed to be due to cellular changes in the anterior horns of the spinal cord. Some time later he described (with Bouchard) the miliary aneurysm and the rôle it plays in the cause of cerebral hemorrhage; he followed this in 1867 with lectures on cerebral hemorrhage and softening of the brain. About this time, too, appeared contributions on locomotor ataxia, with elaboration on the associated pains, crises and arthropathies to this day associated with his name. Heretofore regarded as rheumatic mani-

festations, he showed clearly their relation to tabes. So revolutionary was this work that he was invited to St. Thomas' Hospital, London, to give a series of similar demonstrations.

In 1859 he described the condition of intermittent claudication.

The study of tremor, perhaps one of his best efforts, was begun about 1867-1868. To this end he made use of long plumes attached to the head dress of his patients, whom he had paraded before him. The oscillatory variants thereby produced aided him in distinguishing the tremor of paralysis agitans from that of disseminated sclerosis and,



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(This illustration has been taken from *La Revue Neurologique*.)

ipso facto, the differentiation of these two diseases. Tremor, hitherto regarded as a disease, Charcot relegated to the status of a symptom, to take its place along with pain, cough or variation of temperature.

The first description of disseminated sclerosis is conceded to Cruveilhier, but it remained for Charcot in 1868 to differentiate it from other tremor-producing diseases and to give the first accurate clinical and pathologic descriptions of the disease. Before this time it was a curiosity of the autopsy room, and no one had as yet made a diagnosis in the living patient. Pathologically, Charcot demonstrated the plaques,

described accurately their pathogenesis and conjectured on their rôle in the causation of the periodic ameliorations observed in this disease.

Then came, in 1869, his discovery of amyotrophic lateral sclerosis, known also as Charcot's disease. His earlier studies on secondary degeneration of the spinal cord enabled him to demonstrate for the first time complete degeneration of the entire motor pathway in this disease. He later differentiated the myopathies from the neuropathies and established their diversity of origin and, with Marie, described the peroneal type of muscular atrophy.

Perhaps his best work in the neurologic field is that on cerebral localization. This embraces a series of lesions (compiled with Pitres), the fruit of a long and accurate study of symptoms and their correlation with actual lesions verified at autopsy. The old conception that the brain functions as a whole was badly shaken by the experiments on animals of Hitzig in Germany and of Ferrier in England, but proof of analogous relations in the human brain awaited Charcot and his pupil. The prerolandic convolution was not only linked with motor paralyses, but definite reference of the muscles of the leg, arm and face to its upper, middle and lower portions, respectively, was made. Further observations revealed not only the concentration of the motor pathways in the internal capsule but also a similar combination of the sensory pathways which, Charcot concluded, must pass through the capsule just posterior to the motor tract. Fundamental study of the arterial supply to the capsule and its surrounding structures is epitomized, anatomically and physiologically, in the artery of Charcot.

In these lectures, Charcot dealt at length with focal epilepsy but carefully conceded priority to Hughlings Jackson, whose name he associated with this condition.

The fundamental value of these and other observations on cerebral localization in paving the way for the brilliant triumphs of surgery of the brain which were to follow carries its own implication. These, with many other excellent contributions in organic neurology, would in themselves suffice to install Charcot as the greatest neurologist of his day—perhaps of any day, but it was to his work on the neuroses that he owes his far-flung fame as a teacher and investigator. Here was his greatest effort and, incidentally, his greatest mistake.

His entry into this field was, according to Marie, an accident, but it is difficult to believe that Charcot had not previously envisaged the subjection of the vast range of material at his disposal to his famous anatomicoclinical method of investigation. Be this as it may, his advent into psychologic medicine was expedited by the necessary removal of the inmates of the defunct pavilion of Sainte Laure and their segregation in other quarters.



For years past, insane, epileptic and hysterical patients had been herded together in this building under conditions which permitted of the closest intimacy. The hysterical women, accustomed to tending epileptic persons during their attacks, readily learned to reproduce the attack in all its details, so that the identical seizure had become the common prerogative of all the patients. Charcot, on whom fell the duty of separating the hysterical from the epileptic patients, fully realized this state of affairs and fittingly coined the all-embracing term *hystero-epilepsy*. In such an atmosphere, unlike any other at any time, Charcot undertook the study of hysteria.

He approached his task with a mental equipment born of long training in organic disease, in which he learned to link cause and effect in a well defined determinism. In the grand attack, he visualized the inevitable effect of psychic trauma on a vulnerable hereditary predisposition. That his conception of the hysterical manifestations was over-rigid and overperfect, as Marie put it, "cast in a rigid nosological cadre," is scarcely to be wondered at. It was doubtless a special hysteria, the hysteria of the Salpêtrière, as the Nancy School scathingly referred to it, and was not to be met with outside the special atmosphere in which it was conceived. On the other hand, Charcot's description of the conversion phenomena—his so-called stigmas of hysteria—such as the anesthesias, hemianesthesias, contractures, tics, transference of sensibility by means of metal disks and unilateral organic defects, bears the unerring touch of the master.

While it is common knowledge that Charcot's major hysteria, as well as the pathogenesis of many of his famous stigmas, has vanished before the critical analysis of his students, Marie, Babinski and others, there is, as Marie pointed out, much of lasting value in his work, to wit, the demonstration of hysteria in the male and the relation of hysteria to trauma.

Charcot's work in hysteria would not, one feels, have lured him far from the narrow path of science had he not coupled with it his notorious investigation into hypnotism, until then the cult of the quack and the charlatan. After all, it was only an imperceptible step from the application of metal disks in the transference of sensory defects in the hysterical person to the hypnotic phenomena. In cases of hysteria and hypnotism Charcot saw a similar mechanism. Once again neurology was indebted to Marie for smoothing out the pitfalls into which his old master had fallen. He wrote that Charcot seldom, if ever, induced the hypnotic spell himself but left this service entirely to his associates who, in the ardor of their devotion, so repeatedly hypnotized these victims, in private and unknown to the chief, that by the time they were presented to him they were so hypnotically trained that the very purpose of his research was vitiated at its inception.

The furor which accompanied Charcot's doctrine on hypnotism culminated in zealous opposition to his candidature for the Institute, but did not shake his decision to enter the Academy of Science with the same thesis. It is only fair to say that Charcot dealt with hypnotism in a scientific way, that he was impervious to the fears of his friends and the calumnies of his enemies and that, in the end, he saw fit to discard hypnotism as a therapeutic measure, deeming it superfluous and even dangerous. In his last essay on treatment, *La foi qui guérit*, published just before his death, hypnotism plays an insignificant rôle and gives place to logical persuasion and inspiration, the inspiration that only a Charcot could impart.

Finally, that unique contribution wherein he made the first and most complete application of art to medicine of all time demands one's tribute.

Throughout his life Charcot gratified his artistic bent in the collection of paintings, drawings and bits of statuary depicting disease states, especially of the nervous system; when in 1887-1889 he decided to assemble and classify these in his famous albums on "Demonomania in Art" and on "The Diseased and Deformed in Art," he conferred on medicine not the least of his many gifts.

His scientific productions, only a few of which may be mentioned here, stand out today as enduring monuments to his intelligence and industry. But Charcot was more than a producer. He was above all a great teacher. It is probable that no phase of his life's work was more responsible for his world-wide fame and popularity than that of his teaching.

At the Salpêtrière the mornings were given up entirely to teaching; Tuesdays and Fridays, to his official public lectures, and the remaining mornings, to private conferences with his students.

The official lectures—the *leçons de mardi* and later the *leçons de vendredi*—delivered before an audience of over 600 persons, comprised of students, distinguished visiting physicians and the intellectually élite of Paris, partook of the spectacular and theatrical and so invited the calumnious attacks of his less successful competitors who saw, with concern, their students steadily drawn to the lure of the great neurologic mecca. This spectacular setting, with its stage, footlights and spotlights, so severely criticized by jealous competitors or unsuccessful imitators, surely lends itself to a more generous judgment than that of light comedy or mere buffoonery. The vast audience, generously sprinkled with the best minds in medicine, art and literature, held in rapt attention throughout the discourse, easily nullifies any such contention.

A more likely explanation of the spectacular nature of these lectures is to be found in Charcot's lack of vocal expression. A "low-voiced man," at no time capable of oratorical excellence, confronted with an increasingly vast audience, he did not hesitate to seek compensation in the

development of his natural gifts—his singular powers of mimicry, his indomitable will and his disregard of petty criticism. What matter to him that he made use of extra lights or, through his innate sense of acting, reproduced in mimicry a gait, a convulsive march, a tic or a spasm, so long as he could the better portray the clinical features of his material?

That his teaching had unusual merit may be gleaned from the opinion of Marinesco, who, having heard all the noted teachers of Europe, found none to compare with the old master, or from the more universal opinion of those who crowded his lecture room to "standing-room only" capacity.

A Socratic interrogation of the patient, followed by a clever elucidation of the more striking clinical features and their reproduction in mimicry if need be; pertinent reference to the literature, and, finally, demonstration of the relevant pathologic process gave to these Tuesday lectures the air of formality—a weakness which Charcot's rivals expressed as artificiality. Being concerned mostly with the elucidation of the principles of neurology, they must necessarily have been formal; but no such stigma can be attached to his daily clinical conference with his pupils. Here he came into close contact with his immediate followers, and with that brevity and lucidity of precept so characteristically his own taught them to see as he himself saw. In the true sense of the word, they were clinical lectures and, above all else, remain among the most highly cherished memories of his pupils. Doubtless the wish to impress clinical events on the minds of his listeners had much to do with the elaboration of the artificial aids with which he surrounded himself in his public lectures.

If it is true that the measure of successful teaching is the scientific attainment of the pupil, then indeed Charcot was a great teacher, for in Marie, Babinski, Pitres, Gilles de la Tourette, Marinesco, Janet, Souques and many others he launched a school of neurology which to this day continues to reflect the genius and inspiration of its founder. These lectures, the envy and aim of the medical world, were of his own creation and, in spite of official discouragement which for twenty years defeated his purpose of establishing an outdoor clinic, became the most influential teaching machine of the day. His dominating personality was great enough not only to attract a following such as no other teacher of the day could boast, but also to surround himself with leaders in the various specialties which he associated with his clinic. There one finds Parinaud in charge of the department of ophthalmology, Richer and Meige successively directing the department of artistic anatomy and Pierre Janet creating the department of psychology, as well as ably directed museums of photography and pathology—all of which gives the lie to the criticism that Charcot's clinic was a one-man clinic.

The afternoons were devoted to private practice and consultations. A crowded consulting-room, accommodating patients from every quarter of the globe, with like privileges meted out to prince or pauper, bears salient tribute to Charcot, the physician.

On one occasion, while Charcot was examining a patient, his attendant brought in a message from Princess X, asking that she be seen before her turn, as she could wait no longer. There was no response from Charcot. When, some minutes later, the request was repeated, he replied: *C'est une étrangère; elle ne sait pas que nous avons pris la Bastille* ["She is a foreigner; she does not know that we have taken the Bastille"].

The slavish punctuality which characterized his daily routine is no better shown than in his conduct of a consultation. He arrived at an appointment just in advance of the designated time and left promptly on the stroke of the clock if his confrère failed to appear.

Charcot's personality can be described only as grand. To those who knew him from a distance, he was cold and austere and often formidable and impatient; but to those who enjoyed closer intimacy, who knew him in his home as well as in the clinic, his cold, imperious exterior harbored a warm and sensitive personality, given to numerous kindnesses and charities which he took not a little pains to conceal. On the surface one might see him as he entered or left the Salpêtrière, bartering a few sous or a pipeful of tobacco against the future delivery of a spinal cord; but few knew that he personally directed a concealed, charitable campaign through the agency of his wife or a trusted servant.

Passionately fond of animals, he never missed an opportunity to befriend one and, though he tried, he could not bring himself to make use of them in experimental physiology—a weakness which explains the paucity of his achievements in this field. And yet his greater vision realized the indisputable rôle played by living animals in the advancement of medical science and dissuaded him from forming an alliance with the antivivisectionists so often suggested to him by their great protagonist, Madame Claude Bernard. Again, when Pasteur was viciously attacked in the Academy of Medicine for his activities in animal experimentation, Charcot was the first to rise to his defense.

Charcot's wide knowledge of the current medical literature was always at the disposal of his students, to whom his kindly and paternal relations extended beyond the walls of the Salpêtrière.

An innate love of home, a happy marriage to a charming lady of social and intellectual distinction and two brilliant children—a son, Jean, and a daughter, Jeanne—furnished a fitting background to his home in the Boulevard St. Germain and his summer residence in Neuilly, both of which reflected the artistic and intellectual tastes of their creator.

His weekly receptions, open to students, visiting physicians and the intelligentsia of Paris, softened by the presiding charm of his wife and daughter, were the antithesis of his biweekly functions at the Salpêtrière. The cold austerity and frowning imperiousness of the dominating master gave way to geniality, brilliant repartee or playful participation in a hoax, as occasion prompted.

An occasional "night off," contrived by his pupils that they might see him laugh, found him ensconced in the front row of the Folies Bergères in full enjoyment of his much-loved French pantomime. But his moments of relaxation were few. A life of zealous endeavor and devotion to duty began to take its toll, and during his last few years he suffered from attacks of angina which compelled him to take longer and more frequent vacations. These were further encouraged by Madame Charcot in her desire to save him the indignity of repeated attacks in the press and through cowardly anonymous letters portraying imminent death from rupture of his own "artery of Charcot." That Charcot examined carefully, treated and refused a fee from one such self-confessed author who, in his regret and despair, sought the best opinion he knew, amply acclaims his charity and his nobility of mind.

His last trip to his beloved country was in August 1893 when, accompanied by his former students and friends, Debove and Strauss, he visited the Marvon. How happily this excursion began, how keen the repartee between the chief and the brilliant Debove and how enthusiastically he commented on the scenery, the old landmarks and the simple lives of the inhabitants is all beautifully set down in a letter written by René Valléry-Radot to his wife. "It would seem," wrote Valléry-Radot, "that Charcot had regained his youth."

The bitter irony of this remark lies in the fact that Charcot was already dead, for three days previously, on Aug. 16, 1893, while stopping at a small inn on Lac de Setons, he was seized suddenly with an attack complicated by edema of the lungs, and in great distress, clutching the arms of his chair, attended only by his two old pupils, died in less than half an hour.

It is given but seldom to any nation to produce a real man of the world whose interests, devotion to duty, dearth of professional envy, appreciation of worth wherever found and benefit to humanity at large raise him far above the level of petty nationalism. France may boast of several such benefactors, but in none are these qualities better personified than in Charcot, the physician of the Salpêtrière.

That he was so regarded even among national enemies is amply evident in the words of Möbius as translated by Garrison:

Science and Art and Benevolence have no country and so far a man like Charcot belongs to the whole world. Men of his kind break down the narrow boundaries between nations. When a nation produces a great man whom all the

world honors and loves, he becomes a power for peace that nullifies the barbaric trait of national hatreds. The more a great man retains the best traits of his people, the more he obliterates the illusory distinction between nationalism and internationalism. Charcot was a Frenchman to his fingertips but void of all the usual narrowness attaching to patriotism.

He was a patriot who was fair to the just deserts of foreigners.

He was a model for his countrymen, and to us he demonstrates how much of beauty and excellence may be revealed in any nation.



## Clinical and Pathologic Notes

### SUBACUTE COMBINED DEGENERATION OF THE SPINAL CORD

#### Report of a Case Following Childbirth and Complicated by Spinal Epidural Hemorrhage

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AND

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CHICAGO

While cases of subacute combined degeneration of the spinal cord following childbirth or occurring during pregnancy have been occasionally mentioned in the literature, cases of this disease in which hemorrhages took place in the epidural spinal space are altogether unknown. In the older literature, hemorrhages in the parenchyma of the spinal cord, especially the gray matter, have been described repeatedly (Minnich,<sup>1</sup> Rothman,<sup>2</sup> Teichmüller,<sup>3</sup> Rheinboldt<sup>4</sup> and others) in subacute combined degeneration of the cord, but they have not been mentioned in the exhaustive studies of later observers (Russel, Batten and Collier,<sup>5</sup> Woltman<sup>6</sup> and Henneberg<sup>7</sup>). The microscopic effusions of blood occasionally observed in this condition are accidental or agonal.

As, in the case to be reported, the foregoing conditions—childbirth, subacute combined degeneration of the cord and epidural hemorrhages—were combined, a discussion of such an unusual combination will be of interest.

#### REPORT OF CASE

*History.*—A white woman, aged 32, who was seen by one of us (T. T. S.) in consultation with Dr. T. G. Wallins, had been in good health until three years previously (1931), when, two weeks after a normal delivery, a clumsy, awkward gait developed. This grew progressively worse; the extremities gradually became

Read before the Chicago Neurological Society, Nov. 15, 1934.

From the Department of Nervous and Mental Diseases, Northwestern University Medical School, and the Neuropathology Laboratory, University of Illinois College of Medicine.

1. Minnich, B. W.: Ztschr. f. klin. Med. **21**:25 and 264, 1893; **22**:60, 1893.
2. Rothman, Max: Deutsche Ztschr. f. Nervenhe. **7**:171, 1895.
3. Teichmüller, W.: Deutsche Ztschr. f. Nervenhe. **8**:385, 1896.
4. Rheinboldt, M.: Arch. f. Psychiat. **35**:44, 1902.
5. Russel, J. S.; Batten, F. E., and Collier, J.: Brain **23**:81, 1900.
6. Woltman, H. W.: Brain Changes Associated with Pernicious Anemia, Arch. Int. Med. **21**:791 (June) 1918.
7. Henneberg, R., in Lewandowsky, M. H.: Handbuch der Neurologie, Berlin, Julius Springer, 1911, vol. 2, p. 769.

rigid, and the patient frequently stumbled and fell, especially in the dark. On several occasions she injured her back. After a fall on April 12, 1934, three years after the onset of the difficulties in gait, the lower extremities became more rigid, adducted and flexed at the knees and hips. Retention of urine developed two days after the fall, and a dull aching was experienced in the inguinal region, but there were no sharp, radiating pain and paresthesias. The family history and the habits of the patient were good. There was no history of infectious or other diseases.

*Examination.*—The patient was rather pale; the lower extremities were very spastic and markedly adducted and flexed. Some voluntary flexion movements could be performed in both thighs, but none in the toes, feet and legs. All these were paralyzed. Because of the great rigidity, no knee or ankle jerks could be elicited. A Babinski sign was present on the right, and on the left it was indefinite. No other pathologic reflexes were demonstrable in the lower extremities. In the upper extremities, the reflexes (triceps, biceps, radial and ulnar) were normal bilaterally. The lower abdominal reflexes were absent; the upper ones were diminished, and a positive Beevor sign was present.

*Sensibility:* The sense of position was lost in the lower extremities; the sense of vibration was absent in the toes, metatarsals and malleoli up to the middle third of the right leg and was absent about 2 inches (5.08 cm.) below the left knee. The sensibility for pain was normal throughout, except for an area about the size of a large orange over the left buttock. No abnormalities were detected in the cranial nerves, fundi and speech.

*Laboratory Data:* There were 3,440,000 red blood cells, 9,600 white cells and 70 per cent hemoglobin. No abnormal red cells were present. The Wassermann reaction of both the blood and the spinal fluid was negative. The urine was normal. The spinal fluid was yellow, did not coagulate and contained no cells, but its globulin content was increased. The pressure, which was about 300 mm. of water, did not increase on coughing, straining or pressure on the jugular veins (presence of a complete block).

No analysis of the gastric contents was made. Roentgen examination of the thoracic portion of the spine revealed no atrophy of the pedicles and no increase in the interpedicular spaces of any of the thoracic vertebrae.

The temperature at the time of admission was 98 F.; the pulse rate, 92, and the respiration rate, 28.

*Diagnosis.*—On the basis of the foregoing findings—a slow onset with progressive ataxia and increasing spasticity, the presence of a spinal block at a definite level and of the Beevor sign—a diagnosis of subacute combined degeneration of the cord and of an extradural neoplasm at the level of the tenth thoracic spinal segment was made.

*Operation and Course.*—On April 23, laminectomy was performed at the Masonic Hospital, at the level mentioned, where a large blood clot (fig. 1) was detected "attached to the right eighth spinal nerve." The clot measured 2.2 by 2 by 1.4 cm., was soft and somewhat "resembled a cyst." It was easily removed. Two days after the operation the spasticity of the flexors and adductors "disappeared," but improvement in the motor paralysis became apparent only eleven days after the operation (slight motion appeared in the toes and feet). The Beevor sign disappeared, and the sense of position became normal, but the sense of vibration, the paresthesias (numbness and tingling) in the lower extremities and urinary retention persisted. Repeated lumbar puncture yielded a colorless spinal fluid, under a pressure of 150 mm. of water and without evidences of a spinal block. In spite of some signs of improvement the general condition of the patient

grew steadily worse. The pallor increased, and there were marked shortness of breath on the slightest exertion and lack of response to treatment with liver and blood transfusions. Death occurred two weeks after the operation (May 7).

*Necropsy.*—No macroscopic changes were present in the spinal cord or the epidural space.

*Microscopic Observations:* The blood clot removed at the operation consisted of fairly well preserved red cells and many white cells, some of which were packed with coarse pink granules. Such cells, which were identified as eosinophil elements, were unusually numerous and were also present in the meshes of the delicate capsule of fibrin that enveloped the blood clot. Signs of developed connective tissue elements, such as fibroblasts, were not in evidence within or around the blood clot.

*Spinal Cord:* Only blocks from the dorsolumbar region and the conus medullaris were available for histologic examination. As figure 2 shows, changes were present throughout the white substance. Thus, in the posterior, lateral and anterior columns there were rarefied, vacuolated areas (*status spongiosus*), which are considered characteristic of subacute combined degeneration of the cord. Some vacuoles were empty, since their contents had dropped out. Other vacuoles, when stained by the methods of Alzheimer and Mann or Bielschowsky or by nuclear

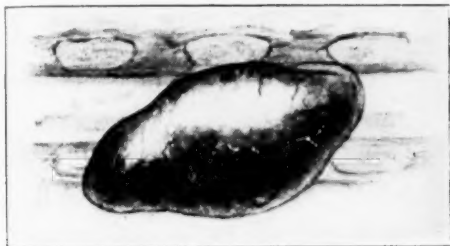


Fig. 1.—The epidural blood clot.

stains, exhibited the presence of myeloclasts, myelophages and, occasionally, gutter cells, that is to say, of elements that denote a degenerated condition of a nerve fiber. In addition to such fibers, there were also normal nerve fibers in the spongelike areas, often in the form of small bundles. Blood vessels in these places were patent, and the adventitial spaces of their walls were filled with gutter cells.

More advanced nerve degeneration was present in the areas of the white substance of the spinal cord that appear in figure 2 as homogeneous, solid nerve tissue. One such area was especially conspicuous in the posterior columns (*A*). No vacuoles could be discerned there (in the center, especially), and under a high power lens the area exhibited cytoplasmic astrocytes, glia fibers and numerous patent blood vessels infiltrated with gutter cells. However, even in such areas, generally designated as glial scars, an occasional normal nerve fiber could be discerned.

A different type of tissue was represented in each column by the dark masses (*B*) bordering on the gray substance, which they encircled and separated from the spongelike and scarlike areas. The dark-stained areas contained normal nerve fibers, among which cytoplasmic astrocytes were scattered. Blood vessels here were few and showed no infiltrations by gutter cells. The gray substance exhibited no changes in the ganglion cells, but the glia appeared rather rich in astrocytes and thin glia fibers, while the blood vessels, like those of the preserved white

substance of the spinal cord, were entirely normal. Hemorrhages or circumscribed foci of softening were not present in either the white or the gray substance, while the pia-arachnoid appeared hyperplastic.

In the lumbar region the histologic changes were similar to those in the lower thoracic region. In the conus medullaris they were present only in the marginal areas of the lateral columns, in the form of cytoplasmic astrocytes.

*Summary of the Clinical and Pathologic Observations.*—Paraplegia in flexion developed after a fall in a middle-aged woman who had been suffering for three

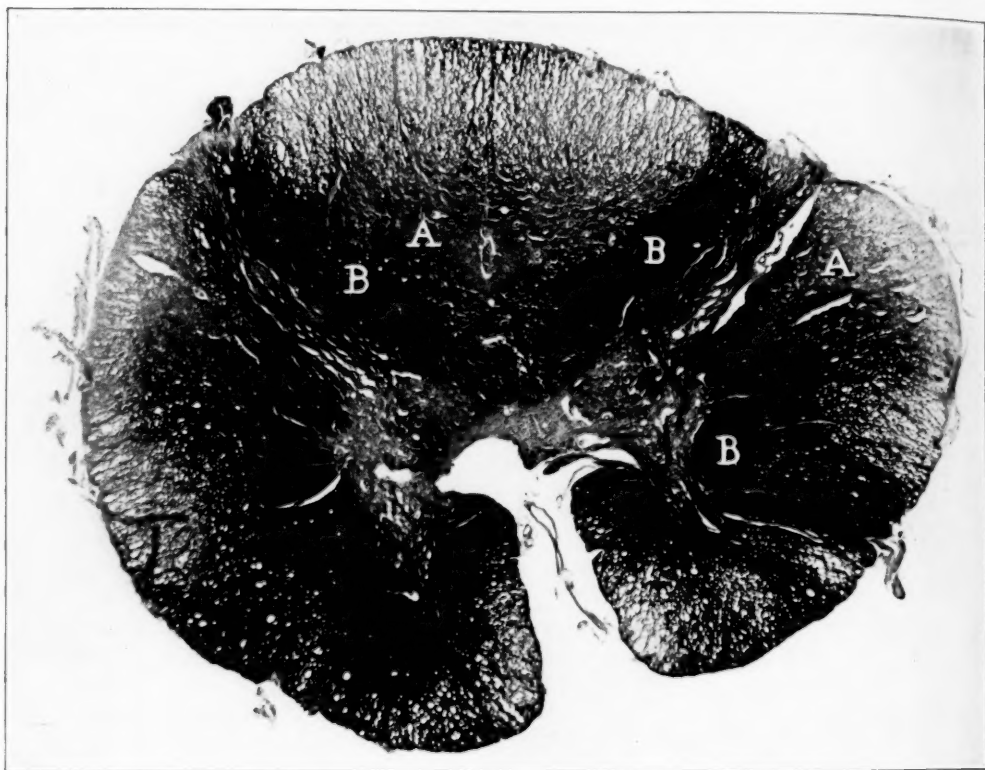


Fig. 2.—The lower thoracic segment, showing status spongiosus. Vacuolated areas are well seen in the various columns of the spinal cord. *A* indicates a homogeneous area representing the glial tissue scars; *B*, a normal area.

years from subacute combined degeneration of the spinal cord which followed childbirth; marked improvement of the paraplegia followed operative removal of the epidural blood clot; death occurred from anemia which did not show changes typical of the pernicious type; pathologically, a typical picture of subacute combined degeneration of the cord was present.

#### COMMENT

The noteworthy features of this case were: the onset of subacute combined degeneration of the spinal cord after childbirth; traumatic hemorrhage in the

epidural space, with marked aggravation of the spasticity in the lower extremities which resulted in paraplegia in flexion, and, finally, absence of changes in the blood typical of pernicious anemia.

The effect of pregnancy on the spinal cord was observed by one of us (G. B. H.<sup>8</sup>) in a young girl who, like the present patient, exhibited no changes in the blood typical of pernicious anemia. Yet the pathologic picture was that of subacute combined degeneration of the spinal cord. The latter developed in the case under discussion after childbirth, which is an exceedingly uncommon etiologic factor. Russel, Batten and Collier<sup>5</sup> mentioned it in only two cases. However, it would probably be more proper to consider not the childbirth but the pregnancy the actual cause of the subacute combined degeneration of the cord, which in turn may be considered in some cases a manifestation of toxemia of pregnancy.<sup>8</sup>

Of great interest also are the nature of the epidural hemorrhage and its possible connection with the changes in the spinal cord and the exacerbation of the clinical picture. As has been mentioned, hemorrhages in the spinal cord were occasionally described by older observers, but these were most likely agonal. In the present case, the hemorrhage was in the epidural space. The blood clot contained well preserved red cells and exhibited no connective tissue elements or signs of the formation of a capsule of connective tissue. The hemorrhage was thus of recent date, in contrast to the general changes in the spinal cord, which, as has been pointed out, were in some areas of long standing and in the form of glial scars. The hemorrhage caused marked aggravation of the clinical picture (increase in spasticity in the lower extremities and paraplegia in flexion) and undoubtedly resulted from a fall, for the patient, because of severe spasticity and ataxia, was subject to frequent falls. These, however, did not aggravate the condition until the last accident, after which an operation revealed an epidural hemorrhage. The latter thus was superimposed on already existent damage to the spinal cord and thus caused additional pathologic lesions, with the consequent exacerbation of the clinical picture. If the patient had not suffered from subacute combined degeneration of the spinal cord, the epidural hemorrhage most likely would have caused only the usual signs of paraplegia without the flexion component. Unfortunately, the segments of the spinal cord corresponding to the level of the epidural hemorrhage were not available for examination. Other epidural lesions (tumors, abscesses, lymphogranuloma) always reveal at the levels of the latter areas of rarefaction and paraplegias as the inevitable clinical sign. With the removal of the epidural pressure, rarefaction subsides, and the clinical picture improves. As has been emphasized elsewhere,<sup>9</sup> the rarefaction of the spinal cord is in such cases a manifestation of stasis of the tissue fluids or edema of the cord. In our case the stasis was the additional pathologic lesion which was the cause of paraplegia in flexion. The latter can probably be considered in this particular case a manifestation of a sudden aggravation of a disease process in a cord already severely damaged. Such an explanation—a sudden or gradual exacerbation of a pathologic process in the cord (or other parts of the central nervous system), its overloading, as it were, with destructive lesions—may also be true of paraplegia in flexion in general.

8. Hassin, G. B., and Ettleson, A.: Paraplegia of Pregnancy (Subacute Combined Degeneration of the Cord): A Clinicopathologic Study, *Arch. Neurol. & Psychiat.* **32**:1273 (Dec.) 1934.

9. Hassin, G. B.: So-Called Circulation of the Cerebrospinal Fluid, *J. A. M. A.* **101**:821 (Sept. 9) 1933.

## CONCLUSIONS

Subacute combined degeneration of the spinal cord may develop during pregnancy and become more manifest after childbirth.

Hemorrhages may occur in subacute combined degeneration of the spinal cord and are either agonal or traumatic.

When traumatic hemorrhages occur in the epidural space, they may cause temporary aggravation of the clinical picture until removed by laminectomy.

## DISCUSSION

DR. RICHARD H. JAFFÉ: I am much interested in the question of pernicious anemia and combined degeneration of the cord because in my experience the pathologic changes are frequently demonstrated; I am convinced that the anemia is not the cause of the degeneration, but occurs simultaneously. I wish to ask Dr. Hassin whether the infection that the woman contracted may have been the starting point for the changes in the spinal cord.

DR. VICTOR E. GONDA: I understand that after surgical removal of the blood clot changes in the sensibility were noticed: The sense of position improved, but the sense of vibration did not. This observation may be of importance because, if substantiated, it suggests that one tract may need more pressure to lose conductivity than the other.

DR. GEORGE B. HASSIN: The changes were, as in any other case of subacute combined degeneration of the cord, degenerative. They showed nothing to suggest an infection of the central nervous system.

In reply to Dr. Gonda, as several tracts are usually involved in subacute combined degeneration of the cord this condition offers poor opportunities for studying their specific functions, especially if one considers the fact that even many healthy-looking fibers may not be entirely normal.



## News and Comment

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### VOCATIONAL PLACEMENT IN PSYCHIATRIC SOCIAL WORK

In view of its interest in promoting standards of placement in the field of professional psychiatric social work, the National Committee for Mental Hygiene has cooperated informally for a number of years with the Joint Vocational Service, a national non-profit-making placement agency for social workers and public health nurses. Recently the cooperative relationship existing between the two agencies has been established on a more formal basis, corresponding in general with that which already obtains between the Joint Vocational Service and certain other national agencies, such as the Family Welfare Association of America, the National Organization for Public Nursing and the Child Welfare League of America.

Under the new arrangement, requests from employers and from applicants for placement in psychiatric clinics or hospitals may be addressed, as formerly, either to the National Committee for Mental Hygiene or to the Joint Vocational Service. It will be understood, however, that all requests not referred in express confidence to one or the other agency will be handled in consultation, and that the required fee for placement will be collectable by the Joint Vocational Service. The National Committee for Mental Hygiene will bring to bear its knowledge of individual workers, local possibilities and desirable standards, while the Joint Vocational Service will make available its highly pertinent experience in placement and its exceptional file of records on personnel.

### FELLOWSHIP IN EXTRAMURAL PSYCHIATRY

A limited number of fellowships for training in extramural psychiatry have been provided by the Commonwealth Fund. These fellowships will be administered by the National Committee for Mental Hygiene, through whom fellows are to be assigned for one or two years to a selected child guidance clinic, the term and plan of the fellowship to be determined by the peculiar needs of the fellows. Candidates for fellowship award should have had at least two years of training in psychiatry in a service of an approved hospital for mental diseases in addition to other qualifications fitting them for extramural service. This provision of training fellowships comes in response to a definite paucity of personnel in this field. Accordingly, conditions as to age, sex, marital status, etc., must be governed by individual cases and by the nature of the current demand. Requests for further information about the fellowships and applications therefor should be addressed to Dr. George S. Stevenson, The National Committee for Mental Hygiene, Room 822, 50 West 50th Street, New York.

### INFORMATION CONCERNING WILLIAM ELLERY LEONARD

An authorized biographic and critical study of William Ellery Leonard and his work is being prepared by Miss Clara Leiser, 7 Park Avenue, New York, who wishes to communicate with psychologists, psychiatrists and neurologists who have been in communication with Professor Leonard by letter, have met him personally or have definite opinions concerning his neurosis as written of in "The Locomotive God." She promises to return all material promptly.

**REMOVAL OF OFFICES OF AMERICAN PSYCHIATRIC  
ASSOCIATION**

The American Psychiatric Association announces the removal of its offices to the New York Academy of Medicine, 2 East 103d Street, New York, because of rapid growth in recent years in membership and activity. The location is accessible and convenient; the professional adjuncts of the Academy, including the medical library are available for use, and the quarters are comfortable and spacious enough to meet the requirements of the staff of the Association and to furnish adequate meeting rooms for the various committees of the Association.

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**CORRECTION**

In the article by Drs. D. E. McBroom and Royal C. Gray, entitled "Idiopathic Epilepsy in Identical Twins," which appeared in the April issue (*ARCH. NEUROL. & PSYCHIAT.* **31**:824, 1934) the 0.5 cm. in parentheses at the end of the second line under Comment, on page 835, is incorrect; it should read (1.27 cm.).

## Abstracts from Current Literature

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THE INSTINCTIVE EMOTIONAL LIFE OF BIRDS. HERBERT FRIEDMANN, Psychoanalyt.  
Rev. 21:381 (Oct.) 1934.

This scholarly article offers an analysis of the manifestations of instincts and emotions of birds and makes an attempt to correlate this material with corresponding material in human beings. In substance, Friedmann states that the emotional life of birds is on an instinctive level, on the nonconscious plane, as far as its driving force is concerned. Compared with those of human beings, the emotions are poorly developed and relatively limited in their modes of expression.

The emotions are of two main kinds: (a) the permanent or self-preservative and (b) the cyclic or race-preservative. Fear, greed and sociability (gregariousness) are the permanent emotions; "love" and its subdivisions and ramifications are cyclic. The type of reaction is constant for each species. Fear is the most prominent of the permanent emotions. Birds do not have the ability to think ahead or to form concepts of things beyond their experience and so do not fear death, the future or the consequences of their acts. The types of behavior reactions induced by fear vary from hyperactivity (almost hysterical panic reactions) to "death-feigning," that is, a type of behavior resembling paralysis. Injury-feigning is a compromise between fear and reproductive emotions. Fear impels the bird to leave its nest; the bond to the nest and eggs or young prevents the bird from doing so; the result is a crippled departure. In some regions where enemies are absent, as in the Galapagos Islands, birds seem to have little or no fear.

Greed involves food, mates, nesting sites and even social position in the flock. Social greed, termed despotism, is the basis of much of the rivalry, intimidations and fights that take place among birds. Stealing is an outcome of this social aspect of greed.

Social and asocial emotions are remarkable in that in most birds they show a radical change at the onset of the breeding season. Gregarious throughout the winter, birds suddenly desire solitude in the spring and establish individual breeding territories in which they do not tolerate others of their own species. This leads to pugnacity when territories are invaded. Pugnacity as such is the result of irritation and disappears as soon as the source of irritation is gone. Hate, as such, does not appear to exist in birds, unless such deliberate persecutions as the mobbing of owls by jays is considered to be an action motivated by hatred. However, when irritation (interference with emotional acts or situations) is great, birds may exhibit blind rage, as do human beings. Cruelty is poorly developed in birds; when actions seem cruel there is usually no apparent pleasure on the part of the bird performing the action. Cruelty seems to be fundamentally an outgrowth of greed. Sympathy is likewise poorly developed and is still in the stage of reaction of the individual as a member of the flock and not as an individual per se.

*The Cyclic Reproductive Instincts.*—Not all of these are fraught with emotional value as far as can be determined. Thus, migration and nest building seem to be purely instinctive, nonemotional activities. Courtship, incubation and care of the young seem to be emotionally conditioned. Courtship behavior involves a number of topics. Essentially, most courtship displays are identical with, or very similar to, intimidation displays, showing the close link between courtship and despotism.

*Behavior Other Than Heterosexual.*—Of these, bisexuality plays an important rôle in courtship; in fact, it is not improbable that the phylogenetic origin of courtship display was in a type of mutual display indulged in by both sexes, with a consequent rivalry for dominance by one, the male usually becoming the dominant member or despot. Bisexuality also shows itself in the matter of artificial stimulation of typically feminine actions in male birds. Homosexuality is latent in

bisexuality. Homosexual behavior is shown in the masculine posturings of some unmated female ducks and in homosexual matings among captive pigeons. Infantilism or at least infantile posturings and reactions are sometimes indulged in by males in courtship display. Auto-erotism may play a rôle in courtship, especially in cases of continuous display of lone, unmated males. Perverse relations akin to vampirism occur occasionally.

Love is poorly developed in birds as compared with human beings. It depends on harmonious conditions and responses for its expressions. If it meets with obstacles it cannot surmount them. Thus, if a young bird is dying the parents do not show more "affection," as do human beings, but lose interest in it or may even kill it. There are no data to suggest love on the part of the offspring for the parents; as far as the attitude of the young is concerned, it is purely a selfish situation. Love for mates does not seem to exist as such except in the cases of species of birds that mate for life. In other species, if one member of a pair dies the other immediately looks for a new mate.

Emotional conflicts and clashes occur not infrequently between opposing emotional drives, with results that may be widely different, just as in human beings; but, with a simple psychic life and a lack of symbolization, the avian responses to such conflicts are easier to interpret. Cases are cited of such clashes between territory and care of young, and attachment to the nest site and care of the young. The behavior and actions resulting from such conflicts are essentially comparable with neuroses, or rather with neurotic reactions, in human beings, but differ from them in that they are less permanent. The emotions are blind and may defeat their own ends in which conditions are not perfect. Other emotions, lying latent within a bird, may be experimentally aroused.

*Dreams.*—Dreaming is known to occur in a number of birds, but little is known about it. In at least one case (that of a bullfinch) the dreams seemed to be comparable with nightmares in human beings.

*Loss of Instinctive Emotions.*—Loss of instinctive emotions (in an evolutionary, not an individual ontogenetic, sense) may occur, as in the parasitic cuckoos and cowbirds, which do not build their own nests or care for their eggs and young. In the cowbirds there is a definite sequence of stages in this loss (or in the evolution of the parasitic habit, to put it in a different way), as follows:

"The most primitive species, the bay-winged cowbird, is not parasitic, but uses old nests of other birds in which to breed. It may fight with the builders for a recently finished nest, and, if it cannot get a nest in any other way, may build one itself.

"The next stage is represented by the screaming cowbird, which is parasitic on the bay-winged cowbird. That it is restricted to this one host species is due to the fact that both breed later in the summer than any of the other birds in Argentina (where these species of cowbirds live).

"The shiny cowbird represents the next stage. It parasitizes a great variety of small birds, but it has the parasitic habit inefficiently developed in that large numbers of its eggs are wasted by depositing them in old abandoned nests or, in some cases, even on the ground, when no nest is available.

"The North American cowbird represents the climax of the series, as it has the parasitic habits in its most perfect, least wasteful form."

The origin of the habit (or the loss of the nest-building and incubating instincts) came during the evolution of the screaming cowbird from the primitive cowbird stock, of which the bay-winged species is the living remnant. In the screaming cowbird there is evidence of an original early breeding season which subsequently become later and later, until the male's instinct to protect a territory could no longer maintain its influence long enough to meet the postponed egg-laying instinct of the female. This left the females in the situation of laying their eggs in nests they had not built and for the care of which they had no instinct, and opened the path to parasitism. The nest-building instinct was already weak in the original cowbird stock; the incubating instinct was lost when the male stopped protecting territory.

On the basis of these observations, Friedmann arrives at the conclusion that the great similarity between so many aspects of avian and human behavior suggests (as might be expected) that human conduct, when stripped of its civilization, morals, learning and other cultural embellishments, etc., is basically not greatly different from that of birds and probably others of the higher animals. This should make it easier to build a structure of comparative psychologic data such as are available for anatomy. If the restricted meanings used in this paper for the various emotional terms are borne in mind one may use them as a beginning on which to build a suitable terminology. Studies of this type rarely appear in psychiatric journals, and to the reviewer they emphasize the need for more comparative studies of this type, on which alone a genuine science of psychobiology can be built.

KARPMAN, Washington, D. C.

VARIOUS WAYS OF EXCRETION OF THE PITUITARY PRODUCTS IN TELEOSTEI: NOTES ON COMPARATIVE HISTOPHYSIOLOGY. PIERRE FLORENTIN, Rev. franç. d'endocrinol. **12**:271 (Aug.) 1934.

The close anatomic relationship between the pituitary gland and the wall of the third ventricle in the Selachii and Teleostei was ignored until about fifteen years ago, when R. Collin and his pupils demonstrated that the products of the pituitary in mammals and birds are taken up by the neighboring tissues and carried to the infundibulum and to the vegetative nuclei in the tuber cinereum. Florentin found a similar situation in lower vertebrates. He used for his study the skeletal fish in which the pituitary cellular elements are in direct contact with the infundibular floor. Such close proximity seems to point, according to Florentin, not only to a close morphologic but also to a functional relationship, which Remy Collin called *neurocrinie hypophysaire*. Florentin made his studies on fresh water Teleostei, namely, *Salmo irideus*, *Cyprinus carpio*, *Tinca tinca*, *Perca fluviatilis* and a few other species. The pituitary proper, that of buccal origin in the Teleostei, consists of two parts, the chromophil or the anterior lobe and the chromophobe or the pars intermedia. The neurohypophysis is an emanation of the infundibular floor. In sagittal median sections it consists of a mass of nerve tissue which forms the lower wall of the infundibular recess and is connected anteriorly and posteriorly with the encephalon by two thin strands of nerve tissue. In frontal section the lateral walls appear to be much thicker than the anterior and posterior, and the infundibular floor sends into the interior of the pituitary gland tracts which penetrate deep into the cellular clusters of the pars intermedia. Except for *Lenciscus*, the Teleostei have no stalk, the hypophysis constituting an integral part of the floor of the diencephalon.

In the chromophil lobe one finds all the cellular elements described in the pituitary of higher vertebrates. In the trout, for instance, there are chromophobe cells, or principal cells, and eosinophil and cyanophil cells. The chromophil cells are usually in the close vicinity of capillaries. Such an arrangement indicates the possibility of unloading the products of secretion directly into the blood stream, as in mammals. This is the *hémocrinie hypophysaire*—the direct method of excretion or the internal method of secretion into the blood stream common to all internal glands.

The chromophobe lobe is traversed by numerous tracts coming from the floor of the diencephalon. This lobe is poorly supplied with capillaries, and those present can be traced to the neurohypophysis (the diencephalic floor). The cells are chromophobe. Some of them migrate into the tracts which come from the diencephalon and during the process of migration undergo transformation into a colloid basophilic mass. This material is also present in the infundibular floor, passing through the ependymal layer and penetrating into the third ventricle. Florentin found the infundibular cavity of *Perca*, *Tinca*, *Cyprinus carpio* and *Phoxinus* filled with this basophilic colloid substance during the spawning season. This constitutes, according to Florentin, the *hydroencéphalocrinie*, a process of excretion which was described before by R. Collin in mammals and birds. Florentin wonders whether

change in the cerebrospinal fluid pressure is responsible for the "aspiration" of the colloid mass through the encephalic wall. Some of this colloid substance seems to migrate further into the infundibular mass, coming into close contact with the neurons of the ventral nucleus in the tuber cinereum. Large pools of colloid can be seen between the large cells of these vegetative centers. The cells here show characteristic nuclear transformations, such as digitation and lobation, changes in shape which were first observed by Scharrer and which, according to Florentin, appear only at the time of hypersecretion of the pituitary and are probably caused by the impregnation of the cytoplasm with the colloid substance. He bases this assumption on the fact that the cells give a colloid reaction. Sometimes he noticed that the invasion of the colloid material was so great, for instance, in the perch, that it led to complete degeneration of the entire cell, leaving in its place a pool of colloid mass. Florentin thinks, however, that restitution of some of these cells is possible, as he was able to find in his sections mitotic and amitotic figures. This he believes is due to the fact that the cells of the vegetative nuclei in the lower vertebrates are less differentiated than those in the cerebrospinal system and retain embryonal potentialities, especially regenerative power. Florentin also thinks that there is in addition a transportation of the pituitary substance to the neurons of the tuber by way of the blood stream. He could see in some preparations capillaries carrying a substance which took the basic stains. He further states that the neurons of the lateral nucleus of the tuber, which is located much higher, are impregnated by the colloid substance with the aid of a secondary *hémocrine* method, the colloid first being absorbed by the numerous capillaries in the ependymal layer of the infundibular floor and carried then to the lateral nucleus. There the capillaries form rich pericellular loops and streams, affording a direct contact with the neurons, thus facilitating a direct passage of the transported substance into the vegetative elements. This brings Florentin to the conclusion that the pituitary gland of lower vertebrates functions in a manner similar to that of mammals, and that the principles of neurocrinia, hydrencephalocrinia and hemo-neurocrinia are also applicable to the lower species. He also believes that the vegetative nuclei in the tuber cinereum and the walls of the third ventricle of the inferior vertebrates receive the products of the pituitary gland during certain seasonal periods.

NOTKIN, Poughkeepsie, N. Y.

SPECIFIC CELLS IN THE HUMAN CEREBRAL CORTEX. MAX DE CRINIS, J. f. Psychol. u. Neurol. **45**:439, 1933.

De Crinis studied the ganglion cells in the various layers of the different areas in the human cerebral cortex by a special silver impregnation method previously described by him (*J. f. Psychol. u. Neurol.* **45**:291, 1933). His findings may be summarized as follows: In the human cortex there are peculiar cells the specificity of which for the regions in which they are found has hitherto not been recognized. The best known specific cells are the Betz giantopyramidal cells; these have been well described before and need no further discussion here.

Resembling the Betz cells in size and shape are Meynert's solitary cells in the fifth layer of the calcarine cortex; de Crinis does not know whether these cells are to be regarded as specific cells. The calcarine region, however, does contain specific cells in the nature of Meynert's giant star-shaped cells in the internal granular layer (IVb); they can be readily recognized, when stained by the author's method, by their well developed dendrites which run in a horizontal direction. The same layer contains also other specific cells, which apparently are related to vision. These cells, de Crinis believes, are the same as those described by Henschen in the visual cortex (IVb) of the night ape; they are relatively large cells the nuclei of which are from 6 to 8 microns in diameter. In the same layer, especially in the midregion, there are found in other apes, in addition to these large cells, small cells the nuclei of which average from 4 to 5 microns in diameter. Henschen concluded that the large cells may possibly subserve the sensation of light and are, therefore, found in all apes, whereas the smaller cells subserve the sense of



color, so that the absence of these cells in night apes may account for the inability of these animals to appreciate colors. De Crinis' method of staining brings out readily the morphologic differences between these two types of cells.

Cajal believed that the auditory cortex contains specific cells, which are the anatomic basis of the acoustic center in the cortex. By employing his new method of staining, de Crinis found in the internal granular layer of the auditory cortex spindle-shaped cells, from 6 to 7 microns long and from 12 to 14 microns wide, with delicate dendrites (mostly only two) extending in a horizontal direction; these cells were not observed in any other layer of the cortex. They occupy Heschl's transverse convolution and the posterior half of the first temporal convolution. Similar cells were found in other regions, but their dendrites were not directed horizontally like those just described. It is noteworthy that the cells that are specific for hearing are found in the internal granular layer (IV), resembling, in this respect, the cells that are specific for vision.

Another type of specific cell is found in the ventral region of the hippocampus as well as in the gyrus olfactorius. This is a peculiar type of pyramidal cell which, on account of its descending, delicately branched basal dendrites, de Crinis designates as a "tuft" cell. As this type of cell could be demonstrated thus far only by the Golgi method and not by his new method, de Crinis is doubtful of its specificity. On the other hand, the peculiar pyramidal cells found in the cornu ammonis are unquestionably specific for this region; these cells can be well brought out by the author's stain; they appear in the form of elongated cone-shaped cell bodies from the apex of which there emerges a fine prolongation terminating without dichotomy on the surface of the cells; they are striking in appearance because they have only one principal dendrite and either no, or unusually delicate, basal dendrites.

De Crinis could also demonstrate by his method in the insula the cells designated by Ngowyang as "fork-shaped cells," but he also found them in the area pyramidalis ammonica. He does not know whether they are of any significance to the sense of smell.

Another peculiar type of cell which he would include among specific cells he found in the parietal lobe (Brodmann's area 7). Although he is not absolutely certain, he believes that this cell may also possibly be regarded as specific for the sensory cortex. Finally, accumulations of cells characterized by the presence of two well developed dendrites separated from each other and at right angles with the cell body were found in the sixth layer of the gyrus postcentralis and parietalis in Brodmann's areas 2, 5, 7a and 7b. One of the dendrites runs straight up perpendicularly and the other horizontally; within the angle formed by these two dendrites there are also found well developed spindle-shaped cells the dendrites of which run only in a perpendicular direction; the latter cells are more numerous and are designated by the author as "circle" cells, whereas the former, owing to the fact that they embrace the latter, are designated "embracing" cells (*Umfassungszellen*). Both of these groups of cells are thought to be specific for sensation.

De Crinis hopes that further investigations may also disclose specific cells in other areas than those described, and he comments on his inability to answer the question whether these cells, the specificity of which is so definite morphologically, may not also be specific functionally.

KESCHNER, New York.

A NEW METHOD OF PHYSIOLOGIC RESEARCH, J. A. M. A. **102**:1401 (April 28) 1934.

At the beginning of one of the chapters of Claude Bernard's "An Introduction to the Study of Experimental Medicine" (translated by H. C. Greene, New York, The Macmillan Company, 1927) he remarks:

"Only within very narrow boundaries can man observe the phenomena which surround him; most of them naturally escape his senses, and mere observation is not enough. To extend his knowledge, he has had to increase the power of his organs by means of special appliances; at the same time he has equipped himself

with various instruments enabling him to penetrate inside of bodies, to dissociate them and to study their hidden parts. A necessary order may thus be established among the different processes of investigation or research, whether simple or complex: the first apply to those objects easiest to examine, for which our senses suffice; the second bring within our observation, by various means, objects and phenomena which would otherwise remain unknown to us forever, because in their natural state they are beyond our range. Investigation, now simple, again equipped and perfected, is therefore destined to make us discover and note the more or less hidden phenomena which surround us."

In harmony with this conception of medical research the invention of new methods of investigation is one of the most likely aids to progress in the development of knowledge. Usually the expectation of the contributions from a novel experimental technic should not be widely heralded until there is a modicum of real accomplishment to its credit. Now and then, however, the enthusiasm for a procedure of promise warrants modest mention. Thus, when physiologists succeeded in extirpating the liver without immediately fatal consequences it was soon evident that real contributions to the understanding of the hepatic functions were near at hand. Again, the ability to separate the thyroid from the parathyroid glands, and the medulla from the cortex of the adrenal, gave assurance that new discoveries in hormone physiology were likely to follow.

Somewhat comparable hope of advancement will be awakened by the new method of electrical excitation of the nervous system by remote control that has been developed in the research laboratories of physics at Harvard University and of the department of surgery at the Yale University School of Medicine by Light and Chaffee (*Science* 79:299 [March 30] 1934). It takes one back to the days of laboratory experiments in the courses in physiology in which electrical stimulation of muscles and nerves was effected by the use of wire coils. Changes in the primary circuit, as in opening or closing it with a "key," induced electrical manifestation in the isolated secondary coil, which could readily be applied to exposed irritable tissues. In the procedure a small secondary coil, usually of 2,000 turns of copper wire, is actually implanted in an animal and one or both of its electrodes are taken to excitable centers. The wound is closed, and after the animal recovers it can be placed within the magnetic field created by a specially designed primary circuit. The latter is entirely away from the experimental animal; but when the latter is placed within the range of the primary coil, induction currents or "shocks" of the most varied character can be developed at selected localities in the body. Thus, as the investigators claim, the apparatus as designed removes the restrictions of time, anesthesia and restraint from experimental exploration of functions susceptible to electrical excitation. It provides a wide range of control of current, frequency and individual wave contour.

With this apparatus, which functions without moving parts, tests made thus far have produced typical jacksonian attacks from stimulation of the motor area in the monkey; a condition of somnolence after stimulation of the hypothalamic region; contraction of the tongue from implantation of the electrode on the hypoglossal nerve; a copious flow of highly acid gastric juice and violent peristalsis from stimulation of the vagus on the lower part of the esophagus. The implanted coils are covered with collodion, and some of these have now remained in place for as long as seven months without evidence of irritation of tissue or of cystic formation. What Light and Chaffee anticipate may be presented in their own words: It is hoped that this apparatus will make possible the study of any function which does not yield to stimulation of short periods but which may respond during experiments in which the excitation simulates the character of that function and goes on, day and night, without disturbing in any way the habits or activity of the animal. It should be particularly useful in the study of the nervous control of autonomic functions such as sleep, sugar and water metabolism, menstruation, blood pressure, normal and possibly abnormal digestive activity and temperature control.

THE CONNECTIONS BETWEEN THE VESTIBULAR NUCLEI, MIDBRAIN AND INTERBRAIN. JOSÉ GUILHERME WHITAKER and LEO ALEXANDER, *Jahrb. f. Psychol. u. Neurol.* **44**:253, 1932.

The investigation reported in this article was carried out on dogs in which the vestibular nuclei were traumatized in vivo and the brains subsequently examined histologically. The authors found that some of the fibers that emerge from the vestibular nuclei enter first the posterior longitudinal bundle and ascend orad as its vestibular portion, forming the tractus vestibulolongitudinalis. From this tract there originate fibers to the nuclei of the ocular muscles, to the nucleus commissurae posterioris and to the nucleus interstitialis. Other fibers arising from this tract go to the nucleus ruber and to the nuclei of the mesial portion of the thalamus, that is, to the nucleus medialis C, nucleus proprius tractus Meynerti, nucleus filiformis and nucleus prependymalis. These fiber connections originate as follows: At the level of the velum medullare anterius, caudad to the nucleus of the trochlear nerve, individual bundles branch off from the ventral circumference of the vestibular portion of the posterior longitudinal bundle and run ventrad so that they reach the paramedian region of the ventral portion of the tegmentum; here they turn in a sagittal direction and run cephalad to the nucleus ruber. At the level of the nucleus oculomotorius, orad to the decussation of the brachium conjunctivae, another set of fibers arises from the same circumference of the vestibular portion of the posterior longitudinal bundle and runs obliquely through the dorsal portion of the tegmentum, which lies between the nucleus ruber and the posterior longitudinal bundle, reaching the nucleus ruber directly. Both of these fiber tracts enter the nucleus ruber at its caudal extremity.

The tractus vestibulolongitudinalis, however, is not confined anatomically to the course of the posterior longitudinal bundle. At the oral end of the posterior longitudinal bundle, that is, at the level of the nucleus commissurae posterioris and the nucleus interstitialis of Cajal, the tractus vestibulolongitudinalis leaves the posterior longitudinal bundle and, perforating the external capsule of the nucleus ruber, enters the dorsomesial marginal portion of the nucleus itself. From here the tractus vestibulolongitudinalis runs sagittally to the oral portion of the nucleus ruber, where it ceases to be a part of the posterior longitudinal bundle and constitutes a part of the interstitial fiber formation of that nucleus. It is noteworthy that from the dorsomesial portion of the nucleus ruber there also arise from the tractus vestibulolongitudinalis a number of brushlike fibers which extend across the entire nucleus to its oral portion.

The fiber bundles connecting the nuclear region of the nervus vestibularis with the nucleus ruber originate from several portions of the vestibular nuclear region, namely, from the nucleus tractus spinalis vestibularis, the nucleus triangularis, the nucleus Bechterewii and the nucleus Deitersi. From all these nuclei arise crossed and uncrossed fibers, varying in number in the various nuclei. The fibers from the nucleus Bechterewii and the nucleus triangularis go chiefly to the homolateral nucleus ruber, only a few fibers going to the contralateral side, whereas most of the fibers from the nucleus Deitersi and the nucleus tractus spinalis vestibularis go to the contralateral nucleus ruber and a few only to the homolateral nucleus.

At the point where the tractus vestibulolongitudinalis decussates with the fasciculus retroflexus, a few fibers of the former join the latter, and together they run dorsad alongside the outer circumference of the fasciculus retroflexus. These constitute the accompanying fibers of Meynert's bundle (*fibrae connectantes fasciculi retroflexi*), and reach the nuclei in the mesial region of the thalamus, that is, the nucleus medialis C, the nucleus filiformis, the nucleus proprius tractus Meynerti and the nucleus prependymalis; in this sense they may be said to represent the thalamic radiation of the tractus vestibularis longitudinalis.

The authors believe that these experimental investigations indicate that in the dog the posterior longitudinal bundle represents a system which connects the vestibular nuclei not only with the nuclei of the ocular muscle but also with the static centers in the midbrain. It would thus seem that the tractus vestibulo-

longitudinalis is the afferent limb of the reflex arc for the labyrinthine static reflexes. In addition, this tract consists of fibers which connect the vestibular nuclei with the thalamus, so that the posterior longitudinal bundle also represents a secondary sensory tract of the vestibular nerve. KESCHNER, New York.

CRANIAL OSTEOMAS AND HYPEROSTOSES PRODUCED BY MENINGEAL FIBROBLASTOMAS. F. ECHLIN, Arch. Surg. 28:357 (Feb.) 1934.

Echlin reports a clinicopathologic study of several types of cranial osteoma and of hyperostoses produced by meningeal fibroblastomas in the collected material of the surgical pathological laboratory of the Johns Hopkins Hospital. An analysis of twenty-six cases of osteoma of the outer surface of the cranium, including nineteen cases reported in the literature, showed the following significant features: There was a history of trauma in eight cases. The onset was usually before or about puberty, and the growth most frequently involved the frontal bone and less frequently the parietal and temporal bones. The tumors are benign, are practically symptomless and grow slowly, the average duration being nineteen years. They are bony, hard, nonmovable masses, generally smooth, rounded and broad-based and firmly attached to the skull but not to the overlying skin. The roentgenographic picture varies according to the stage of development of the tumor. It may appear as a small, button-like tumor on the surface of the outer table, a large subperiosteal bony growth with absorption of the outer table and involvement of the diploe or a spongy or eburnated osteoma lying with its base on the smooth inner table, which may be depressed, and showing on its surface a bony shell.

Histologically, the tumor is either eburnated and composed of quiescent, adult cortical and cancellous bone, or spongy with proliferating, preosseous tissues and young trabeculae of cancellous bone, or it may represent one of various intermediary stages between the two. On the surface of the osteoma is the periosteal fibrous tissue, which shows a gradual transition in its deeper layers through a fibrospindle cell stage to an adult preosseous tissue and from which, it is believed, the osteoma arises. These osteomas are apparently related to those which arise from and fill the frontal sinuses and orbit, and cause early damage to vital structures. Similar early symptoms of pressure may be caused by osteomas of the inner table, which do not show demonstrable changes in the outer table of the skull. Osteomas of the outer surface are an entity distinct from exostoses in cartilaginous bones.

Twenty-seven cases of cranial hyperostoses produced by meningeal fibroblastoma, including eighteen reported in the literature, form the basis of this study. The average age of the patients was 31 years, and the duration prior to operation, five years. The growths were largely localized to the frontal and parietal regions. In fourteen cases the symptomless hyperostosis was noted as the first sign of disease. Headache was the most common symptom, other symptoms and signs depending on the localization of the lesion. The average duration of symptoms at operation was three years and of the hyperostosis, eight years.

Meningeal tumors may cause in the overlying cranium hyperostosis, an erosion, a hypervascularization or a combination of these processes. In general, the roentgenogram shows spongy new bone formation radiating outward from both tables of the skull, more so from the outer table. One may often distinguish the outlines of both tables. Microscopically, the trabeculae of "these hyperostoses are found to be infiltrated with the cells of the meningeal fibroblastoma to a greater or lesser extent."

Hyperostoses may be readily differentiated from osteomas because of the frequent presence of evidence of increased vascularity and of erosion, greater tenderness, presence of intracranial damage, persistence of the outlines of the cranial tables, presence of radiating bony spicules and later age of development.

SPEHLING, Philadelphia.

NERVE ENDINGS IN MAMMALIAN MUSCLE. BRYAN H. C. MATTHEWS, J. *Physiol.* **78**:1 (April 13) 1933.

Matthews describes a method by which the impulses from single sensory nerve endings in mammalian muscle can be studied. He identified four distinct types of receptors and designates them A1, A2, B and C. The rate of response of these receptors is roughly proportional to the logarithm of the tension on the muscle. Adaptation occurs slowly. During active contraction, the responses of the A1 receptors cease; they behave as if they lie parallel with the contractile elements. During active contraction resulting from supramaximal stimulation, the response of the A2 endings accelerates, but if the stimulus is slightly submaximal, the response ceases. Matthews concludes that these endings lie in the muscle spindles, that only during supramaximal stimulation do the intrafusal fibers contract, and that when they do they stimulate the A2 nerve endings mechanically. From the behavior of the A2 endings during twitch, he concludes that in the soleus muscle the intrafusal fibers are relatively more viscous than the ordinary muscle fibers. The B endings have a high threshold, and during contraction they always behave as if they lie in series with the contractile elements. Their response depends only on the total tension on the muscle, whether it is the result of passive stretch or of active contraction. The C endings lie in the fascia associated with muscles; they adapt rapidly and respond only during movement of the muscle; they are few in number and proportionately not of great significance. The time relations of impulses from A1 receptors are slower than those from A2 and B receptors. They are thought to be traveling in smaller fibers.

Evidence is considered from which Matthews concludes that the A1 response comes from the flower spray endings of muscle spindles, the A2 response from the annulospiral endings and the B response from the tendon organs of Ruffini. The central effects of the impulses from these types of receptors are considered; it is thought that the A1 response may be excitatory for the stretch reflex and the B response inhibitory. The function of the A2 response is undecided.

When the circulation of the muscle is occluded, if the motor nerve is stimulated the excitability of the sensory nerve ending at first falls but later rises far above its normal level. Finally, in the absence of stretch, a spontaneous discharge appears; its frequency rises to above 400 per second, and after a minute or two it ceases and the ending is inexcitable until the circulation is released, when it rapidly recovers. This phenomenon is thought to be due to a breakdown of the nerve ending mechanism. This effect is compared with the pain that occurs in man when work is done by muscles with impeded circulation; the two have a number of features in common. Matthews discusses the possibility that the rapid discharge from stretch receptors may evoke pain.

The rhythmic mechanism of the end-organ was examined by observing the disturbance of rhythm brought about by antidromic impulses set up by electrical stimulation. The rhythm is "reset" by antidromic impulses, which are followed by a delay, the magnitude of which depends on the position of the antidromic impulses in the rhythmic cycle of the ending. Theoretical considerations are discussed, and the behavior of a nerve ending and that of the motor neuron are compared; the effects produced by antidromic impulses are alike.

ALPERS, Philadelphia.

HYPPOCHONDRIASIS. ROBERT HUTCHISON, *Brit. M. J.* **1**:365 (March 3) 1934.

Hutchison defines hypochondriasis as "any morbid interest or over anxiety about health." He divides persons with hypochondriasis into the following groups: those with general hypochondriasis, those with nosophobia, cranks, physical prigs, those with parental hypochondriasis, those with filial hypochondriasis and those with communal hypochondriasis. The person with general hypochondriasis is usually a man in advanced middle life, generally retired from business, who collects symptoms as others collect stamps or old china. The condition may mark the beginning of an involutional psychosis. Attempts to bring about cure are useless. The physician should listen to the subject patiently, examine him thoroughly,



reassure him confidentially, give him some explanation of his symptoms, prescribe a placebo and send him away happy. The person with nosophobia is one who has a fear of some particular disease, cancer, appendicitis, etc. The treatment for a patient of this type is to persuade him by the most thorough examination that his fears are liars. Hutchison thinks that many of these cases could be prevented by a little more caution on the part of physicians and others in suggesting certain physical illnesses. The crank is described as the health faddist. In the treatment of such a person ridicule is somewhat effective, but on the whole, unless he is actually doing himself harm, this type of person is best left alone. Here again, Hutchison thinks that physicians are somewhat to blame in that almost every one of these cranks can claim some medical authority for what he does. The physical prigs are mostly young men with an exaggerated standard of health and well-being, who wish to be utterly fit. It is suggested that the medical profession should encourage a movement toward a more scientifically directed physical education for the young, which aims at the harmonious development of the whole body and discourages a lop-sided athleticism. Persons with parental hypochondriasis are best exemplified by the parent who is overanxious about his children. They are found also among unmarried children, especially daughters, who are fussy about the health of an aged parent. In regard to the treatment for parental hypochondriasis, the condition seems to have gone too far to be stopped altogether, but one can refrain from adding to it and interfere only when the fad becomes morbid. Filial hypochondriasis is well meant anxiety over the health of older persons. Hutchison thinks that physicians should use their influence in favor of allowing the old to do in reason as they like, even at some risk to their lives. Communal hypochondriasis is the overanxiety about health which may affect a whole community. It is frequently brought about by agencies the object of which is to produce health consciousness, but which is better termed disease consciousness. In this connection Hutchison thinks that the Workmen's Compensation Act and the National Insurance Act are two examples.

Hutchison is much opposed to individual health propaganda. He believes it to be both useless and mischievous, for while it runs off a duck's back in the case of the healthy-minded, it creates wholesale nosophobia among the anxious. He is also opposed to periodic health examinations in that the good they do is negligible and is offset by the amount of nosophobia which is created thereby.

FERGUSON, Niagara Falls, N. Y.

THE ELECTROPHYSIOLOGIC ANALYSIS OF THE TENDON AND BONE PHENOMENA IN NORMAL PERSONS. O. FOERSTER and H. ALTENBURGER, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **146**:641 (July) 1933.

This article is the first of a series of contributions on the physiology and pathophysiology of the tendon and stretch reflexes. The reflexes were analyzed by action currents measured by a string galvanometer. Action currents taken by electrodes from different parts of the same muscle simultaneously show a striking similarity. This is true in most cases, but in some there may be a difference of several sigmas; the greatest difference noted was 10 sigmas. The amplitude of the action current varies greatly, not only in different heads of a muscle but also in different fiber bundles of the same muscle segment. These values may vary in a series of reflexes, indicating that there is a varying intensity of participation of the same fibers at different times.

The reflex action may spread under normal conditions to other muscles, e. g., the antagonist muscles if the agonist muscles are being stimulated. Foerster and Altenburger studied the antagonist muscles in twenty-five normal persons and found that these muscles take part in reflex action. This does not occur in every case, but it is by no means rare. In the achilles tendon reflex they found participation of the tibialis anticus, and in the patellar reflex, of the biceps femoris. The same holds true for the upper extremity. In the biceps reflex there is activity of the triceps and vice versa. Stimulation of the extensor muscles of the hand and forearm produced action currents also in the flexor muscles. The response in the



antagonist muscles is not uniform. It varies from time to time in the same person. It may be absent at times and present at others. Usually the response of agonist and antagonist muscles is synchronous, but sometimes there may be an interval between the two of from 5 to 10 sigmas. The amplitude is the same in both groups of muscles. The response of the antagonist muscles is more constant in the upper than in the lower extremities.

How can these action currents in the antagonist muscles be explained? Hoffman suggested that it is a purely physical phenomenon, whereby the action current in the agonist muscles simply spreads over to the antagonist muscles. Against this are the observations of Foerster and Altenburger, who claim that the action currents are evidence of reflex activity. This evidence of reflex activity in the antagonist muscles is present in normal persons. Its form is not constant, but it is present.

ALPERS, Philadelphia.

**PATHOLOGIC CONDITIONS OF THE LIVER AND THE HEMATO-ENCEPHALITIC BUFFER.** M. I. LEVANTOVSKY, Ukrain. Psychoneurol. Inst. **20:85**, 1932.

Levantovsky states that histopathologic studies as well as experiments on animals, have established the coexistence of destructive lesions of the liver and lesions of the central nervous system. The lesions are of a degenerative, dystrophic type. Clinically, this relationship had been observed in Wilson's disease, in the pseudosclerosis of Westphal-Strümpell and in epidemic encephalitis. It was thought that the clearly intoxicating character of these lesions was due to the loss of function of such an important organ of metabolism as the liver. To test the resistance of the so-called hemato-encephalitic buffer, the anatomic localization of which is believed to reside in the choroid plexus or in the meninges, the author injected intravenously small doses of vital dyes after producing either operative or chemical injury of the liver. In one series phosphorus poisoning was induced (exogenous toxin); in another a pancreatic diabetes was produced by the total removal of the pancreatic production of endogenous toxins. Operative trauma consisted of the following procedures: desympathization of the liver in one series, ligation of the hepatic artery in another, production of Eck's fistula in a third, and Eck's fistula followed by ligation of the hepatic artery in the fourth. The following observations were made: Neutral red, "cyanol" and iron were recovered from the cerebrospinal fluid only after phosphorus poisoning or after Eck's fistula with ligation of the hepatic artery. Trypan blue and congo red (colloidal dyes) were not recovered in any of the experiments. Crystalloid dyes passed the buffer only after the induction of the gravest pathologic lesions of the liver. The permeability of the buffer apparently did not determine the degree of changes observed in the central nervous system. The changes in the cortex of the brain and in the subcortical ganglia bore no definite relation to the severity of the lesions of the so-called hemato-encephalitic buffer. For example, grave lesions of the brain were observed, while the ependymal elements, the meninges and the choroid plexus showed only mild changes. After phosphorus poisoning and after Eck's fistula, the blood vessels of the brain showed the most pronounced lesions, and in these cases the dyes were recovered from the cerebrospinal fluid. The author was not able to establish a specific relationship between the function of the liver and buffer substances. He was inclined to regard the vascular apparatus of the brain as the anatomic substratum of the so-called hemato-encephalitic buffer.

EDITOR'S ABSTRACT.

**THE CHILDHOOD OF HELEN KELLER.** JAMES KERR LOVE, Brit. M. J. **1:114** (Jan. 20) 1934.

Helen Keller became completely blind and deaf at the age of 19 months. Love attempts to discover what became of the impressions gathered in Helen's mind and stored away somewhere during the nineteen months of seeing and hearing. It is evident that memory in her case goes back to the second year. She is positive that she remembers a tremendous pain in her eyes and a fear of light. These,

with screaming and tossing about, were features of the illness which destroyed her sight and hearing. The names of things soon went, the label was lost, but were the names the things stood for quite forgotten? Accumulated evidence points to the conclusion that such was not the case. On the arrival of her teacher, at the age of 7, one of the first things that Helen did was to take her teacher's hat, which lay on the bed in the room, put it on her own head and stand before the mirror, preening herself and adjusting the hat to various positions. When Helen was a baby she often did this thing. When given a pipe with which to produce soap bubbles, without any hint she put out her hand to feel for the bubbles. It was known during her seeing period she had, with a friend, produced such bubbles. She said that when she puts her hand into soap bubbles and the sun shines on them she feels them sparkle and quiver. Heat is always associated in her mind with light, and when she stands before a fire or radiator she always turns her face upward as she did and does to the sun. When given a banjo, she at once began to twang the strings. An old Negro used to strum a banjo in this manner during her hearing period, and she had seen him play it. Her dreams have been visual. A common dream is of a person putting out her hand "to grasp me," showing evil intent. This person is always black. During her hearing and seeing years she had a Negro nurse. She said, too, that "in my dreams I have sensations, odors, tastes, and ideas which I do not remember to have had in reality. Perhaps they are the glimpses which my mind catches through the veil of sleep of my earliest childhood." Thus it seems that impressions of her early childhood have lost their names, but the percepts have not been lost. They have only faded, and with her imagination she can paint a vivid picture.

FERGUSON, Niagara Falls, N. Y.

ASEPTIC MENINGITIS FOLLOWING DIAGNOSTIC LUMBAR PUNCTURE: INDICATIONS FOR LUMBAR PUNCTURE AND COMPLICATIONS SECONDARY TO IT. K. E. REYNOLDS and G. WILSON, J. A. M. A. **102**:1460 (May 5) 1934.

Reynolds and Wilson report three cases of aseptic meningitis in which lumbar puncture was followed by fever, stiff neck, Kernig's sign, stupor, delirium and a pronounced increase of cells in the spinal fluid, without the discovery of organisms in the fluid by smear and culture and without a reduction in the amount of sugar normally present. Therefore, they believe that the term aseptic meningitis is justified, as no organisms were found, and the spinal fluid sugar, which practically always decreases in amount or actually disappears in ordinary meningitis, remained normal in the two cases. All three patients recovered. The patient with tumor of the brain was subsequently operated on successfully; the woman with cerebral neurosyphilis was actually benefited by the experience, and the patient with chronic encephalitis was not permanently affected but died later of chronic encephalitis. The manner in which the picture is produced is uncertain. Perhaps some particular matter left in the needle after "cleaning" may bring forth an outpouring of cells and in that way produce the condition. Spiller and Payne thought that in their case the meningeal vessels were congested from repeatedly occurring fits (the patient had epilepsy) and that, as the result of relief or pressure, cells escaped into the subarachnoid space. Any foreign substance introduced into the spinal fluid may bring about an aseptic meningitis. Thus, serum or even improperly prepared salt solution or drugs may induce a train of meningitic signs when injected into the spinal subarachnoid space. Drainage of the spinal fluid on two or three successive days seemed to be curative in the authors' patients. The authors state that perhaps they would have recovered without the taps.

[J. A. M. A.]

THE SYNDROME OF EXOPHTHALMIC GOITER AND TUBERCULOSIS. G. RICHARD, Rev. franç. d'endocrinol. **12**:199, 1934.

Richard brings together in this article the results of observations of various investigators and of his own which seem to indicate the existence of an interplay

between activity of the thyroid gland and the course of a tuberculous process. He recalls that Morin, in 1885, noticed improvement in 87 per cent of 348 tuberculous patients who had normal or hypertrophied thyroid glands, while in another group of patients with atrophied glands improvement occurred in 37.8 per cent. A similar correlation was established experimentally in laboratory animals by Charrin in 1898, Frugoni and Grisconi in 1909, Uhlmann in 1911 and Solis-Cohen in 1911. Coulaud expressed the only dissenting opinion when he claimed that destruction of the thyroid gland in rabbits does not render the animals more susceptible to infection and that histologically the thyroid gland in tuberculous animals has a normal appearance. Richard refers to his own observation, made in 1907, regarding the relatively frequent coexistence of exophthalmic goiter and of incontestable manifestations of tuberculosis, and the usual benign character of the tuberculous process in such combinations. He was also impressed at that time with the rather mild nature of exophthalmic goiter in persons suffering from tuberculosis. He mentions also his observations of a dozen patients who showed a spontaneous tendency to recover from a tuberculous process after the syndrome of exophthalmic goiter became manifest. Similar observations were made by Lereboullet and Sabourin. Richard mentions finally the fact that the close relationship between hyperthyreosis and tuberculosis was sustained at the National Medical Congress held in Paris in 1934, thus affirming a view advanced thirty years ago by Morin and shortly afterward by Richard himself.

NOTKIN, Poughkeepsie, N. Y.

ACUTE SYPHILITIC TRANSVERSE MYELITIS. A. M. McCausland, *Am. J. Syph. & Neurol.* **18**:216 (April) 1934.

Instances of acute myelitis are rare in early syphilis and are usually ascribed to therapy with arsenic. In the case here reported, however, myelitis occurred in a patient with untreated syphilis and cleared up following intravenous treatment with neoarsphenamine. The patient, a man aged 24, had a chancre in August and did not receive antisypilitic therapy. In March he experienced a dull headache, with stiffness of the neck and back. He had numbness of one of the lower extremities late in that month and soon was unable to distinguish pain and temperature stimuli over the lower part of the abdomen and lower extremities. He began to drag the left leg, and by April 1 he was unable to walk. On April 5 he suffered from urinary retention. When examined on April 7 he presented a moderately stiff neck, flaccid paralysis of the lower extremities and anesthesia below the tenth thoracic segment. Tactile sensation was preserved, but pain and temperature responses were lost. The spinal fluid contained 83 lymphocytes and gave a 2 plus reaction for globulin; the Wassermann reaction was 4 plus.

On April 12 a course of neoarsphenamine, given intravenously, followed in each instance by a spinal tap, was begun. The dose was 0.6 Gm. for the first two injections and 0.9 Gm. for the remaining four. Iodide and bismuth were also administered. Within five days after the first injection the patient began to void voluntarily. Pain and temperature sensation slowly returned, and improvement in motor control was noted, so that by May 5 the patient could walk normally. The serologic findings showed steady improvement, and in August the spinal fluid contained only 6 leukocytes, while the Wassermann and colloidal gold tests were normal.

DAVIDSON, Newark, N. J.

MEGALENCEPHALY. S. A. Kinnier Wilson, *J. Neurol. & Psychopath.* **14**:193 (Jan.) 1934.

This was the presidential address before the Section of Neurology of the Royal Society of Medicine in October 1933. The term is restricted to normal-appearing, well proportioned enlargement of the brain and its parts. The literature is surveyed to ascertain the normal limits of the weight of the brain in relation to age, sex, race, cranial capacity, body weight and size, and to different social and intellectual classes. Well known attempts to associate abnormal

weights with mental endowment are reviewed. Two personal cases of megalencephaly in children are reported. The distinctive histologic feature in one case was a generalized dysplasia of the ganglion cells, chiefly of the third and fifth cortical layers, consisting "in a flattening of lateral shrinkage and elongation of the cytoplasm of many, its homogeneous coloration and the absence of Nissl granules, and also in a similar oval lengthening of the nucleus, which itself stained very deeply and failed to disclose normal nuclear structure."

The relationship of the growth of the brain, particularly in acromegaly, to any secretion or condition of the endocrine glands has not been convincingly established. However, there is much accumulating evidence to suggest that a neurohumoral mechanism may be responsible for growth changes in the nervous system. The well known neurohypophyseal and sympathetic adrenal medulla interrelationships and the demonstrations of chemical substances "secreted" by the terminals of nerve fibers, particularly of the autonomic nervous system, afford an adequate basis for such postulations. "If the brain contains within itself the apparatus whereby its own trophic growth is regulated, may we not conceive of the brain itself as a gland, its own gland?"

SPELRLING, Philadelphia.

#### CEREBROSPINAL FLUID PRESSURE AND VENOUS PRESSURE IN CARDIAC FAILURE.

WILLIAM G. HARRISON, *Arch. Int. Med.* **53**:782 (May) 1934.

The spinal fluid and venous pressures were compared in ten normal persons; all figures were found to be within normal limits, the former pressure being uniformly higher than the latter. The ratio between the spinal fluid and the venous pressure varied from 1.2 to 2 and averaged 1.6. In ten patients with congestive heart failure, increased spinal fluid and venous pressures were found, but the ratio remained 1.6. The averages were 106 and 64 mm. in the normal group and 415 and 250 in the group with cardiac disease. As the patients improved clinically under treatment the pressures were reduced, and the reductions in spinal fluid pressure ran parallel with those in venous pressure. In thirteen instances patients with cardiac decompensation received spinal taps. Following drainage, the pressure fell in eight cases, rose in two and was unchanged in the other three. Temporary clinical improvement was noted in most cases following drainage. Cisternal pressure was found to be lower in the sitting than in the prone position, and this disproportion was greater in the patients with cardiac disease than in the control group. The decrease in pressure on the medulla which is associated with the sitting position (as indicated by the lower cisternal pressure) offers at least one explanation for orthopnea. Spinal drainage cannot be categorically recommended in cases of congestive heart failure; the spinal tap must be done slowly and cautiously, and removal of the fluid must be slow. In any event, the procedure is not indicated in mild cases.

DAVIDSON, Newark, N. J.

#### DIFFERENTIAL DIAGNOSIS OF ACUTE POLIOMYELITIS. M. B. BRAHDY and M. LENARSKY, *J. A. M. A.* **102**:1358 (April 28) 1934.

Brahdy and Lenarsky discuss the first, second and third stages of the disease and state that of 1,123 patients admitted to the Willard Parker Hospital in 1931 with the diagnosis of poliomyelitis, 113 did not have poliomyelitis but 36 other conditions were diagnosed after clinical study and laboratory investigation in the hospital. There were 28 patients with 10 different conditions who supposedly had poliomyelitis in the first stage; 50 patients with 20 different conditions simulating poliomyelitis in the second stage and 35 patients with 21 different conditions simulating poliomyelitis in the third stage. The majority of these patients should have had a correct diagnosis made by their personal physician, even though the diagnostic difficulties are greater in the home than in the hospital. The family physician sees many patients in the first stage of the disease, at a time when he is unable, with certainty, to establish the diagnosis of poliomyelitis. However, in

many instances it is possible to find some other condition to account for the patient's symptoms. There is a tendency, especially during epidemic periods, to make the diagnosis of poliomyelitis without obtaining a history and making a careful physical examination. As the disease progresses into the second or third stage there are more tangible symptoms on which to make a positive diagnosis of poliomyelitis. Parallel with the increase in the number of symptoms there is an increase in the number of conditions mistaken for poliomyelitis. Nothing is more important than a careful history and physical examination. If, in addition, poliomyelitis is considered as occurring in three stages, the differential diagnosis will be simpler and the percentage of incorrect diagnoses will decrease.

[J. A. M. A.]

SEROUS MENINGITIS OF THE CEREBELLOPONTILE ANGLE: OPERATION, FOLLOWED BY DEXTROROTATORY PARALYSIS. H. ROGER, M. ARNAUD and Y. POURSIÈRES, *Rev. d'oto-neuro-ophth.* **12**:123 (Feb.) 1934.

This report concerns a man, aged 30, who awoke with occipital headache accompanied by vomiting, slight fever and paresthesia of the right side of the face. Examination revealed hypesthesia of the fifth nerve and slight peripheral paralysis of the facial nerve on the right side accompanied by hemispasm, hypoacusis on the right side and a syndrome of cerebellar involvement (adiadokokinesis and hypermetria) of the right hand. A month's sojourn in the hospital ameliorated these symptoms. Sixteen months later the syndrome returned. At that time there existed complete paralysis of the facial nerve, complete deafness of the right ear and vertigo. The right labyrinth was hypo-excitable to rotation; the external rectus muscle was paralyzed. The spinal fluid contained 12 lymphocytes per cubic millimeter and 0.6 Gm. of albumin (with Sicard's instrument); the tension was not increased; the Bordet-Wassermann reaction of the spinal fluid and of the blood was negative. Operation revealed two large arachnoid cysts, one situated behind and to the right of the vermis and the other beside the bulb, and adhesions in the angle. On the second postoperative day complete dextrorotatory paralysis appeared; the head was deviated to the left, and there was intense nystagmus to the left. Improvement occurred, but the patient remained unable to turn the ocular globe to the right beyond the midline. Convergence was possible. This condition is attributed to a new plaque of arachnoiditis compressing the peduncle. Histologic examination of the wall of the cyst revealed only signs of subacute inflammation.

DENNIS, San Diego, Calif.

SUPERINFECTION FOLLOWING MALARIAL THERAPY FOR NEUROSYPHILIS. NORMAN TOBIAS, *Am. J. Syph. & Neurol.* **18**:232 (April) 1934.

Contrary to popular belief, an attack of syphilis does not confer absolute immunity against a second attack. Certainly malaria, really a nonspecific form of therapy, does not destroy the extracerebral spirochetes and does not protect against reinfection. True immunity may exist during the course of the disease, but once the disease has been eradicated this immunity may disappear. However, cases of reinfection and superinfection are extremely rare. Many attempts have been made to inoculate syphilis in a syphilitic person, but so far only one successful case has been reported (Jahnel, quoted by Steiner: *Arch. f. Psychiat.* **76**:109, 1925).

Tobias reports the case of a woman aged 40 who had a clear and serologically verified case of neurosyphilis. She received treatment with tertian malaria (eight paroxysms) and tryparsamide, bismuth and neoarsphenamine; she seemed to be cured when the spinal fluid and blood both showed negative Wassermann reactions (spinal fluid cell count, 8). At the time of discharge the spinal fluid globulin was normal, and clinical symptoms were absent. Ten weeks after discharge she reappeared with a chancre. She gave a history of exposure, and spirochetes were found in the smear. The Kahn and Wassermann tests were 4 plus. The patient improved clinically and serologically after three intensive courses of arsphenamine and bismuth.



Tobias believes that the removal of the infecting organisms (by treatment) in this case restored the tissues to a normal state, destroying the specific anergic state of the skin, wiping out immunity and permitting reinfection or superinfection.

DAVIDSON, Newark, N. J.

SUPPURATIONS OF THE PETROUS TIP. E. P. FOWLER JR., J. A. M. A. **102**:1651 (May 19) 1934.

According to Fowler petrositis is much more common than is generally supposed. Meningitis often brings patients with petrositis to the general physician or to the neurologist. The ocular symptoms occasionally bring him to the ophthalmologist. Petrositis should be considered in the presence of trigeminal pain, paralysis of the abducens nerve or an aural discharge after a well executed mastoidectomy. Petrositis should be watched for on the affected side if the mastoid and zygoma on either side are highly pneumatized. The two sides usually pneumatize in the same fashion. If one side becomes sclerotic, especially about the antrum or hypertympanic region, this sclerotic bone may cut off drainage from the deeper and more pneumatized portions of the bone and so lead to pockets in the mastoid or petrosa. Partial pneumatization may lead exudate into the tip, where it may pocket or extend into the marrow spaces to produce an osteomyelitis. Petrositis usually subsides spontaneously with adequate drainage from the middle ear. If this is not facilitated by the ordinary mastoid operations, further curetting, especially in the peritubal and perilyabyrinthine regions, will often uncover a pocket of pus. Inadequate drainage of the petrosa may result in a chronically discharging ear or meningitis and death. The method of invasion of the meninges may be manifold, either directly through a subdural abscess or through the veins draining the area, through the labyrinth, through the carotid sheath or through the blood stream.

[J. A. M. A.]

THE PATHOGENESIS OF NARCOLEPSY, WITH CONSIDERATION OF SLEEP-PARALYSIS AND LOCALIZED SLEEP. M. LEVIN, J. Neurol. & Psychopath. **14**:1 (July) 1933.

Narcolepsy is defined as the condition in which transitory paralysis with tonelessness, occurring in response to sudden emotion, is associated with morbid sleepiness. In more than two hundred cases of narcolepsy reported in the literature, there are described sixteen cases of sleep paralysis, i. e., a paralysis, local or general, occurring either while the patient is falling asleep or while he is awakening therefrom. The pathogenesis in these cases is explained on the basis of Pavlov's explanation of sleep as an irradiation of inhibition from localized areas of the cortex, which, in the alert animal, is a normal occurrence to the entire brain simultaneously. Cataplexy and sleep paralysis represent a dissociation of inhibition, a "localized sleep," in which the motor centers are inhibited while the substrate of consciousness is still active. Illustrative of the reverse condition is the performance of complex motor acts automatically in sleep, such as walking and talking.

The dispersion of cataplexy and sleep paralysis by extraneous stimuli, such as touch; the occurrence of powerlessness in consequence of the effort to ward off sleep or without apparent cause; the occurrence of hallucinations during sleep paralysis; the occurrence of postdormital paralysis after fear dreams, and the occurrence of sleep attacks as a reaction to pain that must be borne without flinching, phenomena that have been frequently reported in narcolepsy, find a fitting explanation within the folds of this conditioned reflexology.

SPERLING, Philadelphia.

PRESENT TRENDS IN AMERICAN PSYCHIATRIC RESEARCH. J. C. WHITEHORN and GREGORY ZILBOORG, Am. J. Psychiat. **13**:303 (Sept.) 1933.

One of the difficulties which every research worker in psychiatry must face is the setting up of adequate controls. It is, for example, futile to determine the



personality and environmental characteristics of patients with postpuerperal schizophrenia unless at the same time one analyzes corresponding data among a group of recently delivered mothers who remain free from psychosis. Even when a group of presumably normal persons has been established as a control, one can never be sure that significant unconscious factors have not intruded to such an extent as to render the so-called "normal" person a deviate from the average. A second need is a better integration of the technologic training of one group of workers with the psychiatric and psychologic training of another group. The data studied must be interpreted in quantitative terms when possible or desirable to do so; but the worker must not be afraid to engage in activities in which quantification is impossible. A systematization and clear formulation of therapeutic problems and a more complete type of study of clinical material are most essential. The unconscious life of patients must be remembered in making appraisals of the total personality. Psychiatrists should develop a greater understanding of and a greater interest in normal psychology. A generally usable terminology should be developed to facilitate the interchange of reports on phenomenologic observations, without the use of language which would commit the writer to one school or another of psychology.

DAVIDSON, Newark, N. J.

SEQUELAE OF NARCOSIS IN THE CENTRAL NERVOUS SYSTEM. A. MEYER, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **149**:678 (March) 1934.

Blume found peculiar motor and mental disturbances in a cat with respiratory failure during ether narcosis; these persisted for days after the withdrawal of the narcosis. Meyer undertook to study the changes in the brain in cases of narcosis due to ether and carbon dioxide, using cats as his subjects. The animals were killed from three to eight days after the narcosis. In all there was dilatation of the cerebral vessels. In some there were mild fibrotic changes in the meninges and inflammatory infiltration. The brain of a cat which died after seven hours of deep ether narcosis showed dilated vessels, infiltration by plasma cells, lymphocytes and mast cells around the meningeal vessels and swelling of the endothelium. In another cat subjected to narcosis with ether for three hours there were plasma cells in the pia immediately after death. There were generalized disease of the ganglion cells in the cortex, softening in the pallidum, multiple softenings in the cortex and softening in the corpus callosum, caudate nucleus and hippocampus.

The findings are those which have come to be associated with circulatory disturbances. The cortical areas of pallor, with ischemic or severe disease of cells, with complete or incomplete softenings, are not dependent on thrombi or emboli. They are similar to what is encountered in cases of carbon monoxide poisoning. Meyer believes that the changes may be explained on the basis of a vasomotor paralysis.

ALPERS, Philadelphia.

THE BI-COLOURED GUAIAC REACTION IN MENTAL HOSPITAL PRACTICE. S. W. HARDWICK, *J. Ment. Sc.* **80**:87, 1934.

The reaction here discussed was first described by de Thurzo (*Brain* **1**:96, 1929) and is similar in principle to the Lange test in which, under certain conditions, precipitation occurs from a colloidal system. The originality depends on the fact that two dyes, naphthol green and brilliant fuchsin, are contained in the system, one of which attaches itself to the precipitating colloid (brilliant fuchsin), while the other (naphthol green) remains in the supernatant fluid. It is claimed that it is not so susceptible to possible fallacies as Lange's test (such as chemical uncleanness), that it is possibly more selective in its action and that it has the same practical value in the laboratory diagnosis of neurosyphilis. Three hundred and twenty-five cerebral spinal fluids of patients in the Claybury Mental Hospital were examined. The clinical material was drawn from 67 untreated patients with dementia paralytica and 125 patients who had had treatment with malaria and other

forms of pyrotherapy. As control, 103 cases of various kinds were used. On the whole, the reaction resembles the Lange test and is read like it, although the scale is not so high as in that test. The author thinks that the bicolored guaiac reaction is less sensitive than the Lange test in practice in hospitals for mental conditions although there is a fairly close correlation in the cases in which no treatment is given.

KASANIN, Howard, R. I.

THE TREATMENT OF JUVENILE GENERAL PARALYSIS. HOWARD W. POTTER, *Psychiatric Quart.* **7**:593 (Oct.) 1933.

On the basis of a study of sixty cases of juvenile dementia paralytica, Potter concludes that malarial therapy and administration of tryparsamide are the methods of choice for treatment of the condition. Because of its freedom from complicated technic, treatment with tryparsamide is to be preferred to malarial therapy. The patients were divided into two groups: twenty-five with basically inferior intelligence and thirty-five with basically normal intelligence. Of the former group, fifteen became worse or died regardless of treatment; six showed an arrest of the disease process, and four showed improvement. Of the ten who did not become worse, eight received malarial therapy or tryparsamide. In the second group (thirty-five children with basically normal intelligence) twenty-four received malarial therapy or tryparsamide; of these, five became worse or died. On the other hand, eight of nine treated with common arsenicals became worse or died. Of four who had a complete remission, three were over the age of 14. This suggests that, other things being equal, the older the patient at the time of onset the better the prognosis. Other factors favorably influencing prognosis were: normal intelligence before the onset, expansive reaction types, early treatment after onset and confused reaction types.

DAVIDSON, Newark, N. J.

FEMALE HOMICIDES. J. H. MORTON, *J. Ment. Sc.* **80**:64, 1934.

Morton reviews 126 cases of homicide by women which she has observed in the capacity of governor of the Holloway Prison between 1923 and 1932. Women who commit homicide can be conveniently considered under three headings: those who kill their children, those who kill adults, and abortionists. The cases reviewed include only the first two groups. Sixty-four were cases of women who had killed their infants. Most of the offenders were women between the ages of 17 and 40, and most of them were single. More than half of the women complained of either total or partial amnesia, but Morton believes that true amnesia was present in only a few cases. Twenty-four of the sixty-four women showed a definite mental abnormality. Thirty-five women killed their children between the ages of 1 and 12 months, and Morton believes that most of these women suffered from "lactational insanity." The author stresses the strong constitutional trend in such cases and the bad heredity. Twenty-seven women killed children above the age of 1 year. These cases presented special interest, and Morton presents material to illustrate the cases. The reason for the murder was in every case a desire to save the victim from what was considered a worse fate, for this is the underlying principle in practically all murders of infants which came under the observation of the author. This view differs radically from that expressed in a recent review of such cases by Bender (*Journal of Nervous and Mental Diseases* **80**:32 [July] 1934).

KASANIN, Howard, R. I.

SCIATIC NEURALGIA: CLINICAL ENTITY: ITS SYMPTOMS, DIAGNOSIS AND TREATMENT: REPORT OF SIXTY CASES. E. D. W. HAUSER, *J. A. M. A.* **102**:1465 (May 5) 1934.

A study of sciatic neuralgias and a review of sixty cases led Hauser to conclude that this condition is not a true neuritis but an essential reflex sciatic neuralgia, that the referred pain is not confined to the sciatic nerve, that the origin of these

pains may be attributed to muscular insufficiency or physical strain and that any environmental condition which strains the nervous system acts as a contributing factor. The author's ideas are in accord with Linstedt's views that chronic irritations result from functional fatigue; that functional fatigue, in his cases, was secondary to organic alteration of normal body statics; that the irritation of chronic fatigue may make the nerve of the involved part hypersensitive and produce pain along the course of the nerve. When such pains occur in the region of the sciatic distribution they are called sciatica. These views were confirmed by Haglund's vast experience; he also found that the removal of functional insufficiency by means of orthopedic measures cured the sciatica. In the sixty cases that the author reviews, relief was obtained in each case as soon as a functional compensation was reestablished. These observations cover a period of seven years, during which time the patients have remained well.

[J. A. M. A.]

COURSE AND TERMINATION OF THE NERVE FIBERS FROM THE NEOCORTEX OF THE FRONTAL POLE IN GUINEA-PIGS: THE RELATION OF THESE FIBERS TO THE SEPTUM PELLUCIDUM. ADOLF WALLENBERG, *Jahrb. f. Psychiat. u. Neurol.* **51**:295, 1934.

Destruction of the white substance of the left frontal pole in a guinea-pig was followed by degeneration of the following tracts (besides that of parts of the left anterior forceps and of the fibers of adjacent portions of the cortex): (1) fibers to the frontal pole of the right hemisphere running through the genu of the corpus callosum and the right anterior forceps (tractus neocorticalis commissuralis cruciatus) and (2) fibers to the dorsofrontal portion of the septum pellucidum, also running through the genu corporis callosi (tractus neocorticoseptalis), both of which run in the ventral half of the frontal pole and in the most ventral surface of the genu corporis callosi; (3) fibers to the most mesial portions of the substantia nigra, running through the internal (and external?) capsule and the most mesial portion of the pes pedunculi (tractus neocorticoesencephalicus), and (4) fibers to the lateral marginal portions of the corpus interpedunculare (tractus neocortico-interpeduncularis). A simultaneous lesion of the left olfactory bulb produced the well recognized secondary degenerations in the pars olfactoria commissurae anterioris on both sides and in the left tractus olfacto-ammonicus.

KESCHNER, New York.

THE RELATIVE MORTALITY OF CANCER IN THE GENERAL POPULATION, AND IN THE MENTAL HOSPITALS OF ENGLAND AND WALES. G. DE M. RUDOLF and W. R. ASHBY, *J. Ment. Sc.* **80**:223, 1934.

Death rates from cancer in hospitals for mental disease are significantly greater than those in the general population of England and Wales for both sexes. The death rates in hospitals for mental disease and in the general population are approaching one another, the process being more marked in the male sex. The decrease of mortality from cancer does not seem to be due to treatment, nor does the increase in the males at certain ages seem to be due to recurrence following treatment. The increased mortality from cancer in the inaccessible parts of the body in patients of both sexes over 45 is probably due to more accurate diagnoses. For over forty years the death rate from cancer of the upper part of the digestive tract, including the lips, mouth and tongue, has been higher in males than in females. Rudolf and Ashby believe that neither tobacco nor alcohol is the cause of the greater mortality in hospitals for mental disease as compared with the general population, which is contrary to the experience in American state hospitals. Of course, this may be due to the fact that until recently the percentage of autopsies in American hospitals for mental disease has been very low.

KASANIN, Howard, R. I.

ECTOPIC CONE NUCLEI. A. M. CULLER and G. L. WALLS, *Arch. Ophth.* **3**:736 (June) 1930.

This article contains a discussion of the position of the cone nuclei in relationship to the external limiting membrane. It is usual for cone nuclei to lie inside the external limiting membrane, although occasionally some of them are seen to lie on the choroidal side. Such ectopic cone nuclei are most numerous in the central fundus, but they are absent from the fovea centralis. Rod nuclei in man are never found to be ectopic in this relationship to the *membrana limitans externa*. The embryologic formation of these retinal elements and the histology of those ectopic to as well as internal to the limiting membrane are briefly mentioned. Various authorities are quoted freely in this discussion. The authors do not agree with Dimmer that the cells with the ectopic nuclei have a special function. They conclude that such cells are simply a developmental anomaly produced by a minor disturbance of the time relation between the differentiation of the cones and the formation of the true external limiting membrane.

SPAETH, Philadelphia.

USE OF TRYPARSAMIDE IN THE TREATMENT OF TABETIC OPTIC ATROPHY. D. LEES, *Ann. d'ocul.* **171**:449 (May) 1934.

Since February 1927, Lees has employed tryparsamide (pentavalent arsenic) in the treatment of neurosyphilis. Tabetic optic atrophy occurred in 8 per cent of the cases. To avoid the Herxheimer reaction associated with this treatment, Lees preceded the tryparsamide therapy with the administration of iodide for fifteen days, followed by injections of bismuth for a month. Treatment with tryparsamide was begun with intravenous injections of 0.5 Gm. The dosage was gradually increased, the subjective and objective symptoms (visual fields and visual acuity) being observed. The dosage was not increased over 2 or 3 Gm. The injections were given weekly. The treatment was interrupted by periods of rest. The disturbances observed in a small number of cases are not, in Lees' judgment, sufficient to ban a treatment which, if cautiously administered, will cause real improvement or stabilization of the disease, more from the ocular than from the neurologic point of view.

BERENS, New York.

BLOOD AND URINE CHEMISTRY DURING THE SPECIFIC DYNAMIC ACTION OF GLYCINE IN NORMAL SUBJECTS AND IN SCHIZOPHRENICS. CHARLES REID, *J. Ment. Sc.* **80**:379, 1934.

In this thorough study, twenty normal subjects were used as controls. Examination of schizophrenic patients after ingestion of glycine did not reveal any striking deviation as regards the chemistry of the blood and urine as contrasted with that of normal persons. Blood and uric nitrogen factors were no different in schizophrenic subjects than in normal persons during the experiment. Blood urea values in schizophrenic patients and in normal persons after the administration of 15 Gm. of urea in 100 cc. of water were suggestive of delayed absorption, since the rise in blood urea was slower in the former. For this reason the author thinks that the attempt to demonstrate variation in the specific dynamic action of foodstuffs or glycine by the ingestion method is unjustifiable.

KASANIN, Howard, R. I.

CONVULSIONS IN CHILDHOOD. M. G. PETERMAN, *J. A. M. A.* **102**:1729 (May 26) 1934.

Peterman states that a revised classification of convulsions in 500 children demonstrates the basic diagnosis as epilepsy in 33 per cent of the cases, onset of acute infection in 22.8 per cent, cerebral birth injury or residue in 15.4 per cent, spasmophilia in 13.6 per cent, miscellaneous causes in 8.8 per cent and unknown cause in 6.4 per cent. There was no recognized case of cerebral sinus thrombosis, allergic basis, hypoglycemia or hyperinsulinism in this series. Of the convulsions,

6.6 per cent occurred in the first month of life, 13.6 per cent in the second five months of life, 40.2 per cent between 6 and 36 months of age, 26.4 per cent between 3 and 10 years of age and 6.4 per cent between 10 and 15 years of age. In 6.8 per cent of the cases the age of the child at the time of the first convulsion could not be obtained.

[J. A. M. A.]

HOURL-GLASS OR DUMB-BELL TUMOURS OF THE SPINE. HENRY COHEN, *Brain* **57:49** (March) 1934.

The total number of cases of tumor of the spine of hour-glass shape recorded in the literature has been found to be eighty-five. Three cases, which were encountered in a series of forty-two cases of compression paraplegia, are described. The tumors may be wholly intraspinal, with both extradural and intradural masses connected by a narrow pedicle, or the extradural and intradural masses may be joined by a narrow pedicle passing through an enlarged intervertebral foramen. The cause of the hour-glass shape is unknown. Acquaintance with the lesion is the prime essential for diagnosis. Recurrence can be prevented only by removal of both the intraspinal and the extraspinal portion, with the primary attack on the intraspinal part.

MICHAELS, Boston.

EXPERIMENTAL LUMBAR SYMPATHECTOMY. P. E. McMASTER and N. W. ROOME, *Arch. Surg.* **28:12** (Jan.) 1934.

The lumbar sympathetic ganglia and intervening chains were removed on one side in dogs, and the effects on the vascular tree into which an opaque solution had been injected, reactive hyperemia and temperature of the skin of the extremity were compared with similar data for the extremity which had not been operated on. This procedure caused no dilatation of the peripheral vascular tree (i. e., large arteries and arterioles) and did not alter the period of reactive hyperemia in the extremity. Increased temperature of the skin of the side on which sympathectomy had been performed was noted after the effects of the ether wore off; it persisted for about from three to five months.

SPERLING, Philadelphia.

HYPOGLYCEMIC CONVULSIONS WITH HYPOPLASIA OF THE PANCREAS. H. M. WINANS, *Am. J. M. Sc.* **185:500** (April) 1933.

A case is reported in which there was prolonged hypoglycemia with the blood sugar rarely rising above a subnormal level. Numerous convulsions occurred; headache and cough, which do not usually accompany hypoglycemia, were also present. At operation, practically normal pancreatic tissue was found. The following possible causes were considered: (1) overproduction of insulin; (2) disturbance of endocrine glands; (3) tumor of the pancreas, and (4) disturbance of the balance between the external and internal secretion of the pancreas. Winans considers that the last factor may have been operative, with hypoplasia of the pancreas.

MICHAELS, Boston.

OXYCEPHALIA AND ZONULAR CATARACT. AUBARET and GUILLLOT, *Rev. d'oto-neuro-opt.* **12:279** (April) 1934.

The patient had typical oxycephalia with poorly developed intellect. Defective vision was noted at the age of 12 years; vision was 1/10 in the right eye and 3/10 in the left eye. Examination revealed a double zonular cataract, synostosis of the cranial sutures and thickening of the walls of the skull. The interesting question is whether there is an etiologic relationship between the cranial malformation and the alteration of the crystalline lens. Recent studies of the pathogenesis of cataract have shown the influence of the endocrine glands in some cases, especially the important rôle of the parathyroids in cataract and in Paget's disease.

DENNIS, San Diego, Calif.



THE NEURALGIAS OF THE HEAD AND FACE. FREDERICK LEET REICHERT, Am. J. M. Sc. **187**:362 (March) 1934.

The following types of neuralgia are discussed: neuralgia of the trigeminal nerve, atypical facial neuralgia, neuralgia of the sphenopalatine and vidian nerves, migraine, Ménière's disease, so-called geniculate neuralgia, neuralgia of the tympanic plexus and neuralgia of the glossopharyngeal nerve. Only neuralgia of paroxysmal nature should be classified as true tic douloureux. Tic douloureux of the fifth, eighth and ninth cranial nerves has been permanently cured by intracranial division of the respective nerves. The justification for including migraine and Ménière's disease under the classification of neuralgia may be questioned.

MICHAELS, Boston.

RECURRING PTOSIS. E. WOLFF, Ann. d'ocul. **171**:450 (May) 1934.

Wolff describes a case in which ptosis affecting the same eye recurred four times and disappeared without treatment. Later, a cavernous lymphangioma was found near the orbital border. Wolff believes that attacks of inflammation or an intracystic hemorrhage was the cause of the variations in the volume of the tumor which clinically resembled recurring ptosis. These attacks were accompanied by pain, vomiting and elevation in temperature. Wolff suggests the association of this particular syndrome with cavernous lymphangioma. Juler stated that this syndrome in the absence of a tumor should primarily suggest ethmoiditis.

BERENS, New York.

TRAUMATIC ENCEPHALITIS. A. E. BENNETT and H. B. HUNT, Arch. Surg. **26**:397 (March) 1933.

The valuable aid afforded by encephalography from the diagnostic and therapeutic standpoints in cases of relatively minor injuries to the skull is stressed. The symptoms complained of, often unassociated with abnormal neurologic signs, are believed to be caused by a combination of obstruction to the normal circulation of the cerebrospinal fluid from a subarachnoid hemorrhage and edema and diffuse intracerebral punctate hemorrhages. Eight cases in which the encephalograms revealed definite abnormalities are reported.

SPERLING, Philadelphia.

DOUBLE NEURORETINITIS CAUSED BY AN ATTACK OF GRIP, RESULTING IN BLINDNESS. J. D. McCULLOCH, Ann. d'ocul. **171**:457 (May) 1934.

McCulloch observed rapid involvement of the optic nerves in a patient, aged 45, who had had grip. There was no perception of light. The fundi showed pallor of the disks with hazy margins encircled by exudates and dilated veins. There were no hemorrhages. Complete atrophy of the disks appeared in the second week. The Wassermann reaction was negative; the urine, teeth and sinuses were normal. The author points out the rarity of this condition and mentions the cases published in the literature in which disease of the optic nerves is seldom as marked.

BERENS, New York.

DEMENTIA PARALYTICA AFTER CRANIOCEREBRAL TRAUMA. Z. ESMERALDO, Arch. brasil. de med. **23**:173 (Sept.) 1933.

Esmeraldo studied the rôle of craniocerebral trauma in the production of dementia paralytica of which he reports two cases. He also studied the mechanism of action of craniocerebral trauma in the development of the condition and made a differential diagnosis between dementia paralytica after trauma and traumatic dementia. He discusses the subject from the neurologic point of view and presents some medicolegal considerations.

EDITOR'S ABSTRACT.



THE ACTION OF ERGOTAMINE ON THE CHROMATOPHORES OF THE CATFISH (*AMEIURUS NEBULOSUS*). Z. M. BACQ, *Biol. Bull.* **65**:387 (Dec.) 1933.

Ergotamine expands the innervated chromatophores of the catfish and contracts the same cells when denervated. This effect on the innervated chromatophores is opposite to that of epinephrine, but the direct actions of ergotamine and epinephrine on the denervated areas are similar.

COBB, Boston.

THE PONTILE-BULBAR FORMS OF ACUTE POLIOMYELITIS IN THE ADULT. G. ÉTIENNE, *Ann. de méd.* **33**:1, 1933.

Étienne describes a case of acute poliomyelitis which clinically presented a picture of ascending Landry's paralysis. It responded favorably to a combined intraspinal, intramuscular and subcutaneous injection of 100 cc. each of anti-poliomyelitis serum (horse serum of Pettit) and of macacus serum.

WEIL, Chicago.

PUPILS REACTING NEITHER TO LIGHT NOR IN ACCOMMODATION, N. P. R. GALLOWAY, *Ann. d'ocul.* **171**:456 (May) 1934.

Galloway examined a woman, aged 59, who had bilateral fixed mydriasis. The irides responded to no stimuli even when the eyes were adapted to dark. The eyes were normal, and there were no nervous or organic stigmas. The pupils did not show a myotonic reaction.

BERENS, New York.

OCULAR DISORDERS IN GAUCHER'S DISEASE AND NIEMANN-PICK'S DISEASE. NORDMANN, *Ann. d'ocul.* **171**:445 (May) 1934.

Nordmann reports that Gaucher's disease in infants is differentiated from the classic form in adults by the prominence of nervous symptoms. In Gaucher's disease in adults the clinical examination of the eye always gives negative results. Motility is often disturbed in infants affected with Gaucher's disease.

BERENS, New York.

GLIOMA OF THE REGION OF THE QUADRIGEMINAL PLATE. E. PAPKE, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **149**:495 (Feb.) 1934.

Papke describes a case of glioblastoma multiforme arising from the region of the quadrigeminal plate. She says that the case demonstrates that not all tumors arising from this area can be classified as pinealomas, as claimed by Globus.

ALPERS, Philadelphia.

SACROCOCYGEAL CHORDOMA. VICTOR E. CHESKY, *Arch. Surg.* **24**:1061 (June) 1932.

The presence of a sacrococcygeal chordoma the size of a hen's egg is reported in a man of 53. The characteristic features of this type of tumor are briefly reviewed.

SPERLING, Philadelphia.

OPTIC NEURITIS ASSOCIATED WITH ACUTE SINUSITIS. N. P. R. GALLOWAY, *Ann. d'ocul.* **171**:456 (May) 1934.

Galloway reports a case of suppurative ethmoiditis with a large cervical abscess accompanied by bilateral optic neuritis and retinal exudates.

BERENS, New York.

## Society Transactions

### PHILADELPHIA PSYCHIATRIC SOCIETY

*Regular Meeting, Nov. 9, 1934*

JOSEPH C. YASKIN, M.D., *President, in the Chair*

THE PSYCHIATRIST AND THE LAW. MR. F. GILMAN SPENCER (by invitation).

Psychiatrists have probably all asked themselves: Why has the law not kept up with modern psychiatry? Why is it that the test for legal insanity is the same today as it was nearly one hundred years ago i. e., the ability to distinguish right from wrong? Why is it that the method of proving insanity is so inefficient in court and so often unfortunate in its results? Or, in other words, why is insanity in fact not insanity at law?

Insanity as a defense at law is comparatively recent. In 1843, in the celebrated McNaughton case, in which Daniel McNaughton was tried for the killing of Drummond, the private secretary of Sir Robert Peel, Chief Justice Tindall charged the jury that the question for them to decide was "whether McNaughton was capable of distinguishing right from wrong with respect to the act with which he stood charged." And this test, known as the rule in the McNaughton case, or the right-and-wrong test, is the legal test now in effect in England and in most of the United States, including Pennsylvania.

Despite continued and increasing criticism, Pennsylvania, New York and the majority of the states and England hold fast to the right-and-wrong test—a test that was laid down nearly one hundred years ago. Imagine practicing psychiatry today as it was practiced in 1843! What is the true test? Possibly New Hampshire has found the solution in abolishing all legal tests of insanity and holding that the test is whether at the time of the act the defendant had the mental capacity to form a criminal intent. The question of what insanity shall be at law must be, as it is in fact, a question for the psychiatrist alone to define and answer. So much for insanity, the fact. How is that fact to be proved?

At present, when the issue of insanity is raised it is a question for a jury to decide, assisted by the opinion of experts. These opinions are ordinarily presented as answers to hypothetical questions. According to William A. White, the hypothetical question is entirely unfair. The American Psychiatric Association has suggested that it be abolished and a conclusion be offered in its place, based on a study of the defendant—an innovation all would doubtless welcome.

It is not hard to imagine why juries and laymen in general are so skeptical about the value and reliability of expert testimony. Even the New York Court of Appeals, in the case of the People v. Barberi (1896), 47 N. Y. Superior 168-174, said: "It is generally safer to take the judgment of unskilled jurors than the opinions of hired and generally biased experts." Any such statement is utterly unfair; nevertheless the thought must occur to any one: Would the same experts be in such complete disagreement if they were called together in consultation to diagnose a case of mental disease? On the other hand, a recent case from Philadelphia furnishes an instance of a psychiatrist giving an honest, sincere opinion to the evident disadvantage of his own side. In the Talerico trial, Talerico, who shot a policeman, put in a defense of insanity. It was shown that he had epileptic fits. On cross-examination, a psychiatrist, Dr. Leavitt, after stating that the defendant's mental age was 12 and that he had epilepsy, was asked whether the defendant was sane or insane. He replied that he was sane. Talerico was con-

victed. This is an instance of an honest opinion honestly given. Unfortunately, every expert is not so unbiased.

How can one assure the courts of qualified experts offering unprejudiced testimony? Many suggestions have been made. These deal with the problem of the mentally defective offender, both before the trial—that is, at the time of arrest—and at the time of the trial itself, when the issue of insanity is raised by the defendant. The problem of determining insanity at the time of the arrest is of the utmost importance. As it is now, many so-called criminals, actually insane, are arrested, indicted, convicted and sent to prison only to be subsequently transferred to a hospital for mental disease.

Would it not be more efficient and also considerably more humane and economical to sort out the mentally defective persons before the commonwealth has been put to the expense of a trial? Several plans have been suggested for detecting mentally defective persons before trial. One suggestion is that psychiatric clinics be attached to the police department and to the municipal court. Another plan, the so-called Briggs Law of Massachusetts, introduces a new principle: the routine examination before trial of all defendants of certain classes. Every defendant who has been indicted by the grand jury for a capital offense or arrested more than once for the same offense or who has been convicted of felony must be examined by the department of mental diseases. If he is found insane he is sent to an institution. If he is found not insane and is put on trial, the prosecution may call as witnesses the examiners of the department who examined the defendant. The act, I may add, has met with splendid success. It is interesting to note that about 20 per cent of all persons examined were found to be insane.

What has been done as regards the problem of proof at the time of trial, that is, the present practice of taking expert testimony? Many plans have been suggested; some of them have been adopted by statute in various states. All have a common purpose—to secure unprejudiced opinions. In 1930, the American Law Institute in its Code of Criminal Procedure drafted the Model Expert Witness Act. This act in substance provides that when the issue of insanity is raised the court may appoint one or more disinterested qualified experts, not exceeding three, to examine the defendant. The court's experts testify at the trial and may be cross-examined. The defendant or the commonwealth may also call experts. The fees are set by the court and are paid by the county.

All will appreciate the merits of this act: 1. It calls for qualified experts, which eliminates the present practice of permitting any physician to testify in cases in which the defendant's mental status is an issue. 2. It eliminates the element of bias. The experts selected can render a fair, unprejudiced report. 3. It fixes the compensation, eliminating the present practice of the litigant with the most money having the most expensive experts.

Probably the first question that will occur to most persons as regards this act is: Is it constitutional? There is a divergence of opinion on this question. However, that authority on evidence, Professor Wigmore, said, speaking of the judicial appointment of experts: "There seems to be no reason for denying this power (power of the court to appoint experts) in the case of expert witnesses, but on the contrary, the practice should be especially permissible since expert witnesses were historically regarded almost as *amici curiae*, and were called by the court."

Constitutional or not, this act of the American Law Institute is without question a real step forward. Possibly a combination of the Briggs Act with its routine examination before trial and the Model Expert Witness Act for the trial itself offers a solution. After all, by what test shall the problem of insanity at law be determined? How it shall be proved? This problem is in its last analysis one for the psychiatrist to solve.

It has been the psychiatrist himself who has been responsible for the reforms that have been made. The psychiatrist realizes that the question of insanity can best be handled by those who know it. They realize that the answer must be one that is fair to the court, fair to the parties concerned and fair to the psychiatrist and to the profession that he represents.

## WILLS AND TESTAMENTARY CAPACITY. MR. RAYMOND M. REMICK (by invitation).

My discussion will be limited to testamentary capacity as a necessary incident to a valid will.

"The definition of a will with which all are most familiar is that given by Blackstone, which, though it has undergone several verbal changes—without improvement, be it said—stands unchallenged for its simplicity and accuracy. A will, Blackstone says, is a 'legal declaration of one's intention which he wills to be performed after his death.' The essence of this definition is that it is the disposition to take effect after the declarant's death." (Justice Stewart in *McCune's Est.*, 265, p. 523.)

"There is no right of man more seriously regarded or more jealously protected than the right to legally dispose of his property as he wishes after death. His earnest desire is to have his will right in law as well as in disposition, to be thereafter free from the possibility of fraudulent interference and substitution by others. He is equally solicitous that the administrative and judicial officers who enforce his will shall act in the spirit he intended. It is the one time in the span of life that the giver may be unselfishly generous, unsparingly just and whole-heartedly devoted. The curtain thereafter descending prohibits any earthly manifestation of his impressions, and denies to him knowledge of the effect of his dispositions by will, and the power to rectify wrong. While the practice of allowing the owner of property to dispose of it after death is of very ancient origin (*Genesis*, chap. 48, verse 22) it did not exist in certain nations (4 *Kent* 502) and, in England until a more recent period, was exercised under considerable restriction (2 *Blackstone's Com.* 492). It is not a constitutional or natural right, but a creature of statute law, and as such it must be governed (*Kirkpatrick's Est.*, 275, p. 271; *Fricks Est.*, 277, p. 242). The state prescribes a form within which a testator's act may be reasonably safe (now embodied in Secs. 2-6 of *Wills Act of 1917* [*P. L.* 403]) but it must be followed." (Mr. Justice Kephart in *Maginn's Est.*, 278, p. 89.)

From the time of the grant to William Penn (April 2, 1681), the laws of Pennsylvania generally were laid on English principles and rarely failed to show the marks of their English parentage. From the enactment of chapter XLVI of the Great Law on Dec. 7, 1682, "That the Will of no person shall be of force, that is not in his or her Right mind, and usual Understanding, at the making thereof," to the adoption of our present *Wills Act* on June 7, 1917, providing (in Sec. 1) "that every person of sound mind and of the age of twenty-one years or upwards . . . may dispose by will of his or her real . . . and . . . personal estate," the law of the United States has been in agreement with those of nearly every other country that a "sound and disposing mind, memory and understanding" are a necessary ingredient to a valid will.

From its very name and nature the document is supposed to demonstrate the intent of the testator as to the disposition of his property after death. It is the expressed determination of his mind. Only as the mind is sound can its expression be sound. In the absence of a valid will (intestacy) the law has always fixed and determined the manner and proportion of the descent and distribution of the decedent's property and those entitled thereto under the facts and circumstances existing at death. Except as to certain technical results (such as the appointment of an executor or testamentary guardian) the only purpose of a will is to vary this intestate succession. To such purpose should the mind of the testator be directed at the time of the execution of his will. Only a "sound" mind can effectually do this.

To state these general principles, however, falls far short of demonstrating their application by the courts. "It has been said that no will has a brother" and the dissimilarity has been extended to "even more distant relatives" (Mr. Justice Schaffer in *Lockhart's Est.*, 306 Pa. 394). Still more generally could this assertion be applied to human minds. It is difficult to find two persons having minds exactly alike, functioning under all circumstances in a precisely similar fashion.

No precise boundary marks the division of human mentality testamentarily sound on the one side and unsound on the other. No reported case involving

such an issue can be exactly alike in its facts to any other. And as the facts and circumstances of each case differ from the present in former precedents, so differ the opinions and findings of courts with reference thereto. Certain broad rules may, however, be clearly discerned.

A recent modern commentator (Charles Reznikoff in *Corpus Juris*, vol. 68, p. 428, "Wills") has summarized the decisions of the courts on the subject as follows: "The quantum of mental capacity requisite to the valid execution of a will has been stated to be knowledge and understanding by the testator of the nature and consequences of his act. This has been held to include all other essentials. However, subject to slight variations or modifications in the form of expression of the rule by the various cases, testamentary capacity, or a sound mind as the term is applied to the preparation and execution of a will, may be more fully stated to consist of a mentality and memory sufficient to understand intelligently the nature and purpose of the transaction, to comprehend generally the nature and extent of the property to be bequeathed, to recollect the testator's relationship to the objects of his bounty and to those who naturally would have some claim to his remembrance, and to understand the manner and effect of the desired disposition."

Little would be gained by considering the obviously incompetent, that is, the incurably insane, imbeciles, idiots and the like, or, on the other hand, those persons evidencing a clear intellect and intelligence. Persons in society who have property rights they desire to protect have placed such classes each on the opposite boundaries of mental sanity. But what of the borderline cases?

Fortunately, no one can be called to prove one's own sanity. As early as 1640 a learned English authority (Swinburne on Wills, ed. 7, p. 119) stated the ancient principle "that every person is presumed to be of perfect mind and memory, unless the contrary be proved." The same idea is expressed as follows in local courts: "The law presumes every one of full age competent to make a will, of sufficient mental capacity to do the act; therefore, he who alleges to the contrary must prove it to the satisfaction of the jury" (*Landis v. Landis*, 1 Grant, 248). "Testamentary capacity is the normal condition of one of full age, and the affirmative is with him who undertakes to call it in question, and this affirmative he must establish, not in a doubtful but in a positive manner" (*Grubbs v. McDonald*, 91 Pa. 236, both cited and relied on in *Kelly's Est.*, 15 D & C 269).

Memory is essential, but few persons have a perfect memory; nor is that required. A testator's "memory may be very imperfect; it may be greatly impaired by age or disease. He may not be able at all times to recollect the names, the persons or the families of those with whom he had been intimately acquainted; may at times ask idle questions, and repeat those which had before been asked and answered; and yet his understanding may be sufficiently sound for many of the ordinary transactions of life. He may not have sufficient strength of memory and vigor of intellect, to make and to digest all the parts of a contract, and yet be competent to direct the distribution of his property by will. This is a subject which he may possibly have often thought of; and there is probably no person who has not arranged such a disposition in his mind before he committed it to writing; more especially, in such a reduced state of mind and memory, he may be able to recollect and to understand the disposition of his property which he had made by a former will, when the same is distinctly read over to him. The question is not so much what was the degree of memory possessed by the testator as this—Had he a disposing memory? Was he capable of recollecting the property he was about to bequeath; the manner of distributing it and the objects of his bounty? To sum up the whole in the most simple and intelligent form—Were his mind and memory sufficiently sound to enable him to know, and to understand, the business in which he was engaged at the time when he executed the will?" (*Wilson v. Mitchell*, 101 Pa. 495).

Normal business intelligence is frequently made a test. "In considering whether or not testator knew and understood what he was doing when he made his will, we must start, therefore, not only with the fact that he had mental capacity, but



also that whatever weakness of mind existed was not shown to have resulted in any foolish or unbusinesslike act; and this is an important consideration, for 'as a general proposition less capacity is sufficient to make a valid will than to transact ordinary business.'" (Kustus v. Hager, 269 Pa. 103, rel'g. on Thompson v. Kyner, 65 Pa. 368; Guarantee Etc., Co. v. Waller, 240 Pa. 575).

Old age, alone, is no criterion. "A person may be advanced in years and beset with the marked peculiarities of memory and conduct which so often accompany old age, yet if he appreciates, in a general way, who his relatives are, and what property he possesses, and indicates an intelligent understanding of the disposition he desires to make of it, he has testamentary capacity" (Tetlow's Est., 269 Pa. 486; Aggas v. Munnell, 302 Pa. 78).

Nor will sickness, distress or debility of mind either prove or raise a presumption of incapacity (Lawrence's Est., 286 Pa. 58, rel'g. on Wilson v. Mitchell, 101 Pa. 495). Soundness of mind, not body, is the result (Kelly's Est., 15 D. & C. 269).

Also the element of time is essential. The question is not the mental capacity of the testator generally, but that existent at the precise time of the testamentary disposition which may extend over the period required for dictation and execution ("For illustration; in considering the first ground of attack, namely, want of testamentary capacity, the inquiry must relate to that period of time when the will was executed, published and declared" [Watmough's Est, 258 Pa. 22]). Of course, evidence of his condition for a reasonable time, both before and after the actual testamentary act, may properly be given as corroborative of his condition on the particular day (Aggas v. Munnell, 302 Pa. 78, Rel'g on Rubins v. Hammett, 294 Pa. 295).

Mental derangement once shown, however, lucid intervals must be proved. "When once such mental incapacity is established, and the minds of the jury are convinced of that fact, and a general derangement or imbecility of the mind clearly proved, at any time prior to the time when the paper purporting to be a will was executed, then the burden of proof is changed, and those who attempt to establish the validity of the paper, must prove that the alleged testator, at the time of the execution of the instrument, had sufficient mental capacity to execute a will—that she was of sound disposing mind, memory and understanding. It will not be sufficient to give validity to the alleged will, to show that the decedent could return appropriate answers to plain or common questions. But it must be proved that she had mind, memory, understanding and judgment, so that she could, in an intelligible way, dispose of her property" (Landis v. Landis, 1 Grant, 248).

In practice, most will contests are predicated on the disappointment of an heir expectant or an allegedly unreasonable or unjust disposition in the will. Neither, by itself, is of moment. "Incapacity should not be predicated on desire, wishes or unmerited disappointment. To persons who do not receive what they expect under wills, every state of mind responsible for the disappointment is incapacity" (Lawrence's Est., 286 Pa. 58). There is no presumption of mental weakness arising from the fact that the will of the testator may seem to be unreasonable or unnatural in its provisions, or that it makes an unequal distribution among the next of kin, or gives the property to a person other than the natural recipient of the testator's bounty, except where the disposition is so gross or ridiculous as to give rise to a presumption of insanity. Unreasonable or unnatural disposition, with other evidence, may be used to prove incapacity, but, standing alone, it is insufficient" (Lawrence's Est., 286 Pa. 58).

In other words, to contest successfully an otherwise valid will unsoundness of mind must be proved, not merely alleged, and the tendency of courts increasingly has been to uphold wills unless incapacity is clearly demonstrated.

The trial is ordinarily by issue *devisavit vel non* to the common pleas, and the trend of decisions is well illustrated by the language of Mr. Chief Justice Moschzisker (in Tetlow's Est., 269 Pa. 486): "The law is the essence of common



sense, scientifically reduced to general principles, or rules, for the guidance of human conduct and affairs, as they concern the relations of men to each other and to organized society as a whole; these rules take cognizance of, and fortunately endeavor to guard against the known frailties of mankind—one of which is a natural tendency to favor the wishes of the living, rather than those of the dead. While methods for settling disputes of fact, founded on substantial testimony, as to either alleged lack of testamentary capacity on the part of a testator or undue influence operating upon him at the time he made his will, are recognized, yet the law—having given to man the right to dispose of his worldly belongings, so that the distribution thereof, after his death, will accord with such written directions as he may leave behind, provided these are in due form, and not violative of legal requirements, and the author thereof acted at the time of their making with testamentary capacity and without undue influence—takes practical means to prevent twelve men in the jury box from improperly setting aside the duly expressed wishes of a decedent, in a suit by those who, wanting to get possession of his estate, have the stimulus of desired gain, with the great advantage in the legal struggle of the persuasiveness on the jury of their actual presence in court, as against the physical absence of the testator. To protect adequately the legal right of the deceased to dispose of his own property, the law, as administered, most wisely, in view of the known tendency of jurors, already mentioned, places large powers in the hands of the judges who preside, as chancellors, at the trial of such cases; and like powers are in effect conferred on judges of the orphans' court to whom applications for issues d.v.n. are made.

"It is the established law of Pennsylvania that, in cases of the character of the one now before us, the judge is vested with power to decide whether or not he shall submit oral evidence to the jury, even though it be conflicting. It is his right and duty, after weighing the whole evidence impartially, to refuse to present it to the jury unless he either feels the ends of justice call for a verdict against the will, or is so uncertain on this point that he could consciously sustain a finding either way on one or more of the controlling issues involved. If, after so weighing the whole body of the evidence, the trial judge feels sure that his professional and official conscience would not permit him to sustain a verdict against the validity of the will, either because the contestants' proofs lack probative force or are legally inadequate, or because those that are reasonably worthy of credence raise no material conflict on any governing point, or the 'prima facie case' which they present has been 'so overcome by opposing proof as to leave no substantial dispute' (Sharpless's Est., 134 Pa. 250; Fleming's Est. 265 Pa.) it is his bounden duty to instruct the jury peremptorily against the contestants" (Phillip's Est., 244 Pa. 35; Fleming's Est., 265 Pa. 399, 406).

#### DISCUSSION

THE HON. HORACE STERN (by invitation): As a whole, the law has not looked very favorably on psychiatry; it has never been lined up with science. The law has grown up from precedent; it depends on the authority of history—the older the precedent, the more substantial the law. To the law, there are no grays, only blacks or whites; it asks, is the man sane or insane? If he is sane, he is responsible; if insane, he is not. The law deals with realities and draws its sustenance from the habits of the people, but this at times leads to difficulties because many cases deal with the emotional life of a person rather than with his intellect. It is my belief that no person should be sent to jail in any criminal case without a psychiatric examination, and that no man should leave prison without a mental examination having been performed; that when the question of a defendant's sanity is brought into a trial and expert witnesses are called by both sides, the court should be permitted to call a neutral witness.

THE HON. EDWIN O. LEWIS (by invitation): Psychiatry is in its infancy, I believe, but it is going to encounter an extremely powerful enemy. For generation after generation, the attitude toward criminal law on the part of the public has

been sentimental rather than scientific. Juries have been swayed by the personalities of lawyers and by other local considerations. Hence, there have been many bad verdicts and hence bad precedents. There is no reason why these should be followed. This country has outgrown this provincialism. The only scientific attitude toward the law is found in urban communities. Out in the country people do not bother about the scientific aspects of the problems, but in Philadelphia it is necessary to take a realistic position or crime will control us. What is it psychiatry has to combat? It must fight a vigilance committee sentiment that is being aroused because of the frequent miscarriages of justice resulting from the custom that permits lawyers to dominate important criminal trials. People have been imposed on and robbed for much too long a time by criminals. The community has been taxed to support organized parasites. Let us stamp them out by adopting a fair middle ground between these two attitudes—the psychiatric and the brutal—by using every arm of the law to abolish crime and to punish the criminal. A judge who is vigorous and yet humane does more to preserve organized society than any other force in the community. He is the only thing that now stands between chaos and order. I do not have the great admiration for the jury that some of the other speakers have. In an important case—a noted criminal case that arouses a whole community—the jury represents the mass of public opinion. If public opinion says “hang the defendant,” they hang him. If public opinion says “acquit him,” they acquit him. The system is highly unscientific. It is costly to a free country and is one of the reasons why crime has become so widespread in the United States. Successful criminal lawyers understand the human mind and work on it; they build up a reputation by their skill in prevailing on human weakness in jury-men. The lawyer of this type has been too powerful a force, and the time has come for the judge to take control of his court; all should applaud the judge who does so with the purpose of enforcing reason as against sentimentality.

What I have been saying is relevant to the topics of the evening because of the fact that the prejudice prevailing against “mental experts” has arisen because of the willingness of such experts to sell their professional opinions and reputations to defendants in the class of criminal cases about which I have been speaking. If psychiatry is to be the handmaiden of the law and if the psychiatrist is to work side by side with the judge, confidence in the integrity of psychiatry must first be insured by the firm adherence of the members of this profession to the principles that their opinions must be honestly expressed, whether they are for or against the accused and whether the expert is retained by the commonwealth or by the defense. The interests of the state must be adjudged supreme, and the psychiatrist must be held accountable to the courts as well as to his profession for the integrity of the opinions expressed from the witness box. This is much more important than the method of selecting expert witnesses, I believe.

DEAN H. F. GOODRICH (by invitation): A law suit is not a laboratory for the ascertainment of truth. It is a means of settling a dispute between two parties who have not been able to settle it for themselves. Each may honestly think that he is in the right. The judge or the judge and the jury furnish the disinterested tribunal, which is to hear what each party has to say and then decide, as well as can be done, whose claim should be upheld. Each one of the parties to the dispute presents such evidence as he can bring which is favorable to his side. If that evidence calls for excursions into the field of scientific knowledge he calls experts, but experts to present the point of view favorable to him. The tribunal decides the case on the basis of the evidence presented. Perhaps neither side has touched bottom in the well of scientific or of other information available. But the court's business is to adjudicate the dispute and make way for the next litigant. There is much to be said for this method from the social point of view, even though it may result in deciding cases without the benefit of full consideration of everything that might well be said in the individual instance. Judges in the early days had distinctly in mind the preservation of the public peace in the providing of a forum for the settlement of disputes instead of leaving their settlement to physical combat. Even if one assumes that this element is no longer present in a large degree, the

social desirability of settling troublesome points of human affairs with reasonable promptness is very great. The working of the legal system may well be criticized because litigation is too slow rather than on the basis that the exact truth has not been reached. The same general theory is followed in the administration of criminal law. The King's Courts in England functioned as a means of preserving the peace through punishing offenses by the public authority instead of leaving retribution to the matter of private vengeance. Lawyers still think of criminal prosecution as a law suit in which the state and the prisoner are contending against each other on the proof of the charge that the defendant has committed a particular forbidden act. It may well be that there should be a complete change of theory with regard to the nature of criminal prosecution. Perhaps it should be public investigation of the fitness of a person whose conduct is antisocial to remain at large in society. But that is a wide departure from judicial approach to the question, and, if it is made, it cannot be made until after a considerable revamping of the orthodox ideas about crime and criminal law. One physician discovers an entirely new set of facts which requires a complete face-about in the method of treating a patient. The discoverer immediately adopts his new method, and his colleagues will do the same when they are convinced that it is right. It is not necessary to have court action or legislative action or the help of any outside body. But in the law one is dealing with rules governing society in the large. Suppose a change in a legal rule is called for by new facts. A court must be convinced both of the change in facts and of the necessity for changing the rule. If the change is so great as to call for legislative action, the legislature must be convinced of the necessity of the change and its attention drawn from all the other interests which press on it for recognition before a bill can be enacted into law. Not only the legislature must be convinced, but the body politic as a whole must become sufficiently interested to render some degree of public support. It is a long, slow and hard process in most instances.

The legal profession has among its members many persons who are interested in the very type of thing that is being discussed tonight, and there are many hopeful signs pointing to an increasing recognition by those responsible for the law and its administration of the desire to avail themselves of scientific progress in other fields, especially the one under consideration. The American Bar Association, Section on Criminal Law, has had for several years a committee which has worked in close harmony with a number of psychiatrists. Perhaps the best promise for future results is the better training of members of the Bar Association itself. Some experiments are being made at the University of Pennsylvania in giving some supplementary lectures on mental science to law students through the courtesy of Drs. Burr and McCarthy. The students are tremendously interested. No endeavor will be made to make even amateur psychiatrists of them, but they will have at least a knowledge that certain problems exist, and I expect to see them approach questions of the sort discussed this evening with an open and an inquiring mind. Surely an open and an inquiring mind is no small achievement when members of one profession turn to the members of another for guidance and for counsel.

WILLIAM A. GRAY, Esq. (by invitation): There is no question that the law in the state of Pennsylvania today as to the character of insanity which will relieve a defendant from his responsibility for the commission of a crime requires the establishment of the fact of his inability to distinguish between right and wrong; and though this fact must be proved by a preponderance of evidence—if proved at all by evidence of any substantial weight—even though such evidence may be contradicted, it may serve to create in the minds of the jury a reasonable doubt, as the burden of proving the crime never shifts from the commonwealth.

Mr. Spencer asks why insanity in fact is not insanity in law. I suppose the answer to that is that a person may be insane, that is to say, not in his right mind, and yet be able to distinguish between right and wrong. I still believe that the rule adopted by the courts of the state of Pennsylvania is the proper one, but the real question remains. The problem is which method shall be applied in reaching a determination as to whether or not the defendant is insane in the eyes

of the law and if insane whether or not he is to be punished for the crime which he has committed. Some reference was made by Mr. Spencer in his paper to the hypothetical question. Although a hypothetical question which assumes properly all the facts may be introduced in the examination of a psychiatrist in the state of Pennsylvania, a better and more satisfactory practice is to have the psychiatrist who makes an examination of the person whose mind is involved sit in court during the course of the trial and hear the testimony which is introduced and then base his opinion as to the man's sanity on his examination and the testimony which he has heard.

It is true that on many occasions—and this is especially so where people of prominence and wealth are involved as defendants eminent psychiatrists have testified that the defendant was in their opinion undoubtedly insane, and equally eminent psychiatrists testifying on behalf of the prosecution have declared that he was undoubtedly sane. At first blush, the responsibility for this would seem to rest with the medical profession. But medicine is not an exact science, and one must recognize the possibility—or shall I call it a probability—that these physicians, so testifying exactly the opposite, are each of them honest in their belief and that their expression of opinion is the result of their own scientific reasoning, which has at least firmly convinced them of the truth of the opinion which they give. One cannot help but think, however, that these physicians are paid substantial fees by the parties who have retained them and that they will be inclined, in the making of their investigation for the purpose of reaching a conclusion, to look to those things which will sustain the opinion which they are expected by their clients to give. But in my experience, on many occasions I have retained physicians for the purpose of establishing, if it could be justly established, the insanity of a client, and I have been compelled to abandon that defense because physicians whom I have asked to make an examination have reported to me their honest opinion that my client was not of unsound mind. I believe that considerable thought should be given to the question whether a defendant's sanity should not be determined separately by a body of psychiatrists appointed for that purpose prior to the time of the trial. If the question is raised as to whether or not a defendant is insane at the time he is brought up for trial, this question has to be decided before he can be put to trial; it is my belief that the Mental Health Act passed by the legislature of the state of Pennsylvania on July 11, 1923, provides the means for having this done in the case of every person who is made a defendant in a criminal case. I do not mean that the machinery of the law does not provide other means for determining this question, but that the Mental Health Act provides a means for the determination thereof by a body similar to the commission which has been suggested. A step in the right direction has been taken by the legislature of the state of Pennsylvania in the passage of the Act of May 2, 1933 (P.L. 224), but this act applies only after conviction and provides that the trial judge, on his own initiative or on the application of the district attorney, the defendant, counsel for the defendant or any other person acting in his behalf, may defer sentence until a report has been made after a mental examination of the defendant in order to guide the judge in his disposition of the case. Such mental examination, however, must be made by a psychiatrist employed by the state department of welfare or in some state hospital or hospital for mental disease maintained by the county. The report of such an examiner is available to counsel for the defendant and the district attorney. The act further provides that if the report shows that the defendant is mentally ill or mentally deficient, he may be committed to the proper institution, not to be released until the court so orders. I thoroughly approve of the plans suggested by the American Law Institute in that section of the Code of Criminal Procedure suggested in 1930, and referred to in Mr. Spencer's paper.

MR. RALPH B. EVANS (by invitation): I doubt very much whether the administration of the criminal law would be improved if the fate of the criminal or of the insane criminal were left to a jury of psychiatrists instead of to a jury of plumbers, which is what the jury usually consists of under the present practice.

I also venture to suggest that the question of insanity does not turn on any nice matter of words and definitions. Notwithstanding the recommendations of the Committee of the American Bar Association, I do not think that it makes any difference whether one says that the test of insanity is the ability to determine right from wrong or whether one adopts some other definition. Whatever the definition is, my experience is that one can always get a physician, and perhaps a physician who classes himself and can qualify as a psychiatrist, who will go on the witness stand and swear that that patient is insane, however insanity is defined. That is all that is needed to get the case into the lap of the jury. I think that the defense of insanity in criminal cases has been worked to death. I think that the person who commits a crime, whether for the mere pleasure of committing a crime or because of some other strong motivation to the point where he or she is no longer a free agent, is the type of person that society should be protected against, regardless of his or her mental condition. The question of the witness, and particularly of the expert witness, is something to be considered. How can the practice in the matter of expert testimony be improved? There is one way and that is to encourage a little more intellectual honesty on the part of the witness as well as on the part of the lawyer. I have so often seen a physician go on the stand in a civil case and make a statement under oath which he would not dare to repeat in a clinic or at a medical meeting that I know it must happen more frequently in criminal cases. That is wrong. If that fault can be eliminated, if the man who is willing to color his opinion just a little bit to favor the side he is hired by can be eliminated, I think that a great deal has been done to eliminate the vice of expert testimony. I think that if physicians are always as scrupulous on the witness stand as they are in the practice of their profession, most insane murderers would go to the electric chair instead of walking out of the court room, free to kill the next person who happened to arouse another irresistible impulse.

DR. CHARLES W. BURR: The fundamental difficulty in this whole matter is that in the question of insanity in crime the law assumes responsibility, assumes free will and assumes that the healthy man can do one thing or the other as he wills, and the modern psychiatrist assumes that man is a mere bit of protoplasm and that what he does depends not on any will that he has but on the way his particular protoplasm will react in a certain situation. That is the modern psychiatric idea of the mind. Those two views can never come together. They are totally different. The point of interest is whether the present method of determining insanity or sanity in a criminal is a good working method or whether there is some other way that would be better. I have no radical change to suggest, since methods that grow with age have the rightness of age, because old things that survive must be good. The things that are bad die early. But I am sure that there are certain things that could be done that would make this present method work better in getting at the truth.

I am going to find some fault with judges. I have never heard any judge question whether a witness who pretended to be an expert was an expert witness or not. In two months' attendance in the London courts I heard two English judges order expert witnesses from the stand on the ground that they were not experts. I have heard men who had no standing whatever among their professional brothers listened to on the witness stand as experts in mental disease, and the judges, who knew as well as I did that they were not skilled or honest men, did not attempt to get them off the stand. Judges could rid the court of a number of pseudo-experts if they had the moral courage to do it. Another thing, barring the few lawyers who have called me because they knew me and because they wanted to get a true opinion, I believe that many lawyers call a medical witness in a crooked case, knowing beforehand that it is a crooked case and that alleged expert opinion can be bought. So lawyers need some reforming. I understood Mr. Gray to say it would be possible, according to the present Pennsylvania law, to have any criminal examined as to his mental state. Then why do not the judges in all of these cases have criminals examined as soon as they get into jail? I am sure that every once in a while some one who has no money to employ an expert goes



to prison or is hanged merely because no one thought of having a mental examination made. Beyond all this there is a greater problem, and it is this: After all, is the insane criminal worth saving? Personally, I think that he is not. If one lived in a properly run world where reason and not emotion controlled, criminals would be punished, sane or insane. Unless something is done to harden and stiffen the character of the American people of this and of the next generation they will become so sentimental that God alone knows what will happen. So far as my own experience goes, I have seen no harm come from executing an insane murderer.

When judges are strong enough to say who is an expert, and when lawyers are honest enough to employ experts who will tell the truth, then justice will be done. This courage and honesty is needed now. If I were an insane man accused of crime, I would rather have a jury of ordinary men than of psychiatrists. The old-fashioned man would have one opinion and the man with newer ideas would have another opinion, and the jury would be so mixed up they would say, "Let's hang him anyhow."

DR. DANIEL J. MCCARTHY: Many books have been written and modern psychologists have taken the point of view that the law is antiquated and that there should be new rules, but I am in full agreement with Mr. Gray that the right-and-wrong test, the McNaughton test, is by far the most satisfactory test for insanity when insanity is pleaded as a defense for crime. The reasons are simple. As Dr. Burr suggested, if one is going to open the door for responsibility for the murder impulse, then one is going to open the way for crime.

Then there is the question of experts. The lawyer brings in two efficient physicians two years after the crime, and says, "Here is the evidence." He presents the evidence of testimony of persons who have known the defendant, and then one of the experts states in his testimony that the person is insane. The other expert testifies on the stand that he is sane. That is only an opinion, given some time after the crime has been committed, formed from evidence presented. Is it to be wondered at that the case goes from the local court to the supreme court of the state of Pennsylvania, and after being carried to the highest court, that the court will divide five to three? Are they dishonest because they do not agree? One need not agree on cases of this kind. It is purely opinion evidence.

The jury system in England many years ago was very simple. In the country districts of England, when a man committed a crime he was tried by his peers. People knew that John Smith was a man from an epileptic family, that he was seduced by a trollop of a woman and that he committed a crime. They knew the facts of the case, and the jury decided for itself. Is there a jury composed of one's peers in Philadelphia today? No, the jury is made up of plumbers and laborers and poorly educated persons, very often, who sit and listen to the evidence and to the judge. The judge rules that the jury must decide by listening to the answers to questions presented by both sides. They will not allow evidence to show the past history or the surrounding environment. That is the fault with the jury system.

The rankest injustice of all is that the commonwealth can employ high-priced experts, but often the criminal cannot employ experts because he is without sufficient funds. If a district attorney wants publicity for political or for other reasons and gets a case of universal interest, he will draw that case out. He may have an expert who is not concerned with right and wrong, but he will be expected to be biased. He then goes into court with a case that should be settled out of court. I remember the case of a man I saw for a former judge, and I gave the opinion that I thought he was insane. Immediately there was a cry of: "What, and you an expert for the District Attorney's office?"

Dr. Bond and other members of this society have gone to Harrisburg for many years and tried to get something done. At the last judiciary, I said: "I believe I can talk for the psychiatrists and the doctors of Pennsylvania. If the court will agree to select experts with care and to use them in conjunction with other selected experts, more in the manner of a consultation and in order to get their



honest opinion of the case, I am sure they will be willing to serve in this capacity without pay, if necessary. What we do not wish to do is to sacrifice our professional standing." When a physician is asked to go into court and say, "My opinion is this," and the so-called expert says something which is incorrect, the jury does not know the difference and the evidence stands on the court records. If the people of the court will appoint these experts, they will go before the jury and testify in the proper manner. Judges do not know their experts. The examinations that are done today prove this. Dr. Burr and all have come into contact with so-called experts who should not have been permitted to testify. It is necessary to educate the court, the jury and the medical profession. Psychiatrists feel that they themselves need less education than the rest.

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**NEW YORK NEUROLOGICAL SOCIETY AND NEW YORK  
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NEUROLOGY AND PSYCHIATRY**

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ISRAEL WECHSLER, M.D., *President, in the Chair*

**PSYCHIATRY AND THE CRIMINAL LAW: THE PSYCHIATRIC ASPECT. DR. BERNARD  
GLUECK.**

An unbiased view of the criminal situation in contemporary America may be summarized as follows: Security to life and to property is becoming more and more a matter of pure chance in most centers of population, instead of something which every citizen of a civilized community is supposed to be given. Law enforcement and a deliberate attempt to cultivate respect for law are becoming increasingly impossible when there is so much uncertainty as to what mores govern social conduct. The public apathy toward the problem is bred on the one hand by a loss of faith in the integrity of political, social and industrial leadership, and on the other by an ominous and unprecedented intimidation of law-abiding persons in the community. This renders more or less futile any attempt to cultivate an enlightened public opinion in favor of the eradication of crime.

Psychiatry does not offer a panacea for a radical modification of this state of affairs. The problem involves the complete social-economic structure and the tendencies of contemporary American civilization. However, psychiatrists have long expressed a conviction that the only hopeful approach to the problem of criminal conduct lies in the application of a scientific individualized approach which has rehabilitation and reconstruction as its end in place of the traditional impersonal and more or less mechanical procedure that characterizes the legal approach to these problems.

A plea is made for the separation of the guilt-finding functions of the court from the dispositional functions and for the establishment of a federal ministry of justice which because of its prestige and influence might be more effective than any local organization in bringing about necessary reforms. Separation of the guilt-finding from the dispositional function of the criminal court would not only tend to eliminate the unsavory spectacle of the "battle of experts" and the evil of dealing with patients with mental disease by habeas corpus procedure, which opposes the jury's lay opinion to that of the expert clinician, but would carry the promise of a type of individualized treatment for which human maladjustment calls.

Psychiatry, which deals with the behavior of the total personality in all its relationships, is the most appropriate branch of medicine to be entrusted with this treatment. In this instance, however, psychiatry should be supplemented by other technics in the fields of social service—education and vocational guidance. While

psychiatrists do not wish to usurp any of the functions which logically belong in the field of criminal law, they do not feel called on to bow to long imposed restrictions. Why should not the criminal court regard the part played by psychiatry as identical with that of a clinic dealing with cases of human maladjustment? A man accused of crime is brought to trial. Whatever the damage involved, the community must take some action to protect its safety. One can surmise what that action would be if it were left to the discretion of the victim of the criminal act. The judicial process was interposed between the wrong-doer and the victim to avoid vengeful retaliation. Surely, then, the consciously cultivated and cherished motive behind the judicial process in dealing with crime must be something other than retaliation. Its action should be motivated primarily, if not wholly, by the desire to promote social security with the least violence to the individual member. It must use a technic which exercises deterrent influence, or one which will permit the recognition of persons who because of irreversible characteristics of constitution or habit are incapable of being so influenced. Such persons should be segregated so as to prevent them from committing further crimes.

I fail to see why this point of view cannot be accepted in criminal law when physicians consider it the indispensable minimum for dealing with problems of human maladjustment in private practice or in the clinic. Because of the marked improvement in criminal procedure in the past two or three decades, especially on the dispositional side, it does not seem altogether visionary to think of the future court of criminal law as approaching more closely the characteristics of a clinic in human maladjustment. I believe that one can look forward to a day when these courts will become social clinics for the amelioration, and possibly for the solution, of the problems of adjustment to civilized communal living. They will then be dominated by a spirit of scientific inquiry, using every available facility for amelioration and cure. These courts will be operated by an adequately trained personnel, subject to the same professional scrutiny and supervision as is the physician of today. The accused before the bar will then be viewed not as a person who has suddenly become criminal, except in the case of the few usually unpredictable impulsive acts of derangement or panic. Certainly if he happens to be a recidivist in crime he will be dealt with as the product of a process which commonly has its beginnings in childhood or in early youth. Such a person shows fairly definite stigmas of and tendencies to personal and social maladjustment; he thrives by preference in well recognized settings of home and school, in a biologic, economic and cultural background out of which the stream of recidivism in crime flows uninterruptedly.

In short, my principal endeavor has been to focus attention on a broader conception of the criminal law—a conception that will render this instrument more responsive to the changing needs of a changing world, an instrument that will not hesitate to utilize the contributions of the biologic and sociologic sciences as an indispensable supplement for the understanding and the guidance of human conduct and human relations.

PSYCHIATRY AND THE CRIMINAL LAW: THE LEGAL ASPECT. PROF. JEROME MICHAEL.

Just as law touches other fields of knowledge at numerous points, it has many points of contact with medicine, giving rise to medicolegal problems. The most complete cooperation between physicians and lawyers in attempts to solve these problems is urgently required in the public interest. However, in America lawyers and physicians do not work together as they should, partly because the physician does not understand the nature of legal problems and the relation between law and medicine.

While physicians have long and often justly criticized the criminal law and its administration with great severity, it should be borne in mind in considering these criticisms that physicians as such can speak with authority about legal matters only to the extent that medicine contains knowledge which is relevant to

legal problems. Their criticisms have been directed chiefly against the concept and criteria of criminal responsibility and the way in which criminals are dealt with by legal processes. These criticisms cannot be intelligently examined without some preliminary consideration of the nature of the criminal law.

The law makes many and diverse kinds of behavior criminal and provides how criminals shall be treated. Thus, it inevitably raises the questions what behavior ought to be made criminal and how criminals ought to be dealt with by legal processes. But these questions cannot be answered until an even more fundamental question is answered. The basic problem of the criminal law is what end it ought to serve. Two answers have been given to that question: (1) that the criminal law ought to mete out punishment as retribution for crime and (2) that it ought to serve the welfare of the state. The issue thus formed cannot be resolved by any knowledge to be found in medicine but only by an analysis of the nature of justice.

Since law is an instrumentality of the state, its end ought to be the good of the state. It is in the light of this conception of the purpose of law that legal justice must be defined. Laws are just to the extent that they serve the common good. Hence, the criminal law ought to serve the public welfare and ought not to be an instrument of punitive retribution; and to the extent that it is in the public interest that crime should be prevented, the criminal law ought to attempt to prevent crime. However, it is a mistake to assume, as physicians do, that the criminal law ought to serve the end of social security exclusively. This is typical of an error into which physicians almost always fall in thinking about law.

The common good is a vague term which comprises not only the security of person and possessions but all those values which a political society would like to achieve and endeavors to achieve by legal institutions. A system of law serving the public welfare cannot have the singleness and clarity of purpose which medicine has, and the analogy between crime and disease is a false analogy. Such a body of law cannot have singleness of purpose, because no social value, not even security of life, is supreme in the sense that it is to be gained at the cost of all other values; it cannot have clarity of purpose until social judgments regarding the ends of political society have become clear. Thus, while the problems of the physician are questions of method only, the problems of the lawyer are questions of ends as well as of means.

The problem of criminal responsibility is the question of whom it is just to punish, and being a question of justice it is not a medical problem. While, according to the retributive theory of justice, only punishment should be employed in the treatment of criminals, since only pain can serve as expiation for crime, it is nevertheless unjust to punish criminals whose crimes do not involve moral turpitude. But a crime is not a moral wrong unless the criminal was a free moral agent, that is, unless having the capacity to choose between the right and the wrong course of conduct he freely chose the wrong. It is clear that a retributive system of criminal law is not subject to criticism because it embodies the notion of criminal responsibility. Nor is the concept of criminal responsibility subject to criticism as assuming a freedom of will which men do not possess. The law assumes not that human behavior is without cause but only that normal men have the capacity to act deliberately.

Perhaps the severest strictures of physicians have been directed against the criteria rather than the concept of criminal responsibility—against the so-called right-and-wrong and irresistible-impulse tests and the way in which they are administered. They have validly criticized the use of the right-and-wrong test as the exclusive test of criminal responsibility, the law's failure to recognize degrees of responsibility, the rule that a person acting under an insane delusion is to be judged in the same way as a sane man acting under a mistake and the rules relating to the selection and the examination of medical experts.

For the rest, criticism by the medical profession of the criteria of responsibility has seemed to the legal profession to be largely without merit and in part disingenuous. The law does not attempt to define insanity; it defines responsibility

and prescribes who shall be held irresponsible by reason of mental defect or of disease. The law does not disregard psychologic knowledge except so far as it ignores the symptomatic character of delusions. Nor are the criteria of responsibility incapable of application. Psychiatrists claim to be able to answer much more difficult questions than whether a person was suffering from mental defect or disorder when he committed a crime and, if so, whether the crime was of such a character that the offender did not know that his act was wrong or was in any event unable to refrain from doing the act.

It might be supposed that the concept of criminal responsibility has no place in a system of criminal law devoted exclusively to the common good, since in such a system modes of treating criminals ought to be determined by reference to the public welfare rather than to the requirements of punitive retribution. It is just in such a system to inflict pain on criminals to the extent that to do so will prevent crime. However, the average man does not readily distinguish between inflicting pain to punish criminals and inflicting pain on them to prevent crime, and he believes that it is unjust to punish them unless punishment is deserved. The law cannot ignore popular notions of what is just.

If the psychiatrist really wishes to become an integral part of the machinery for the administration of the criminal law, there is no better way to assure himself of a cordial welcome by lawyers than for him to try to understand and wholeheartedly to help the courts administer the criteria of criminal responsibility.

The criminal law can prevent crime only by the treatment of criminals, for only criminals are subject to its processes; and the treatment of criminals can prevent crime only so far as it influences the subsequent behavior of actual and of potential offenders. It is an error to assume that punitive treatment such as imprisonment has no place in a system of criminal law devoted to the public welfare or that the sole purpose of such a system is or ought to be the reformation or rehabilitation of criminals. The infliction of pain on criminals is justified in such a system to the extent that it is efficacious to prevent crime; and crime can be prevented by the incapacitation as well as by the reformation of actual criminals and by the deterrence of potential criminals. Criminals can be prevented from committing further crimes in the community only by such painful methods of treatment as execution, imprisonment and deportation. Potential offenders can be deterred from criminal behavior only by treating actual offenders in such ways as will instill in potential offenders an abhorrence for crime or the fear of being treated like criminals.

The criminal law now attempts to prevent crime by incapacitation and deterrence and, to a lesser extent, by reformation. If it is to be made a more effective instrumentality for the prevention of crime, it must be either by incapacitating or by reforming a greater number of actual criminals or by deterring a greater number of potential criminals. However, in terms of the social good it appears to be justifiable to incapacitate only those criminals who are incorrigible. Moreover, it is probable that punitive methods of treatment are more effective as deterrents than nonpunitive methods, but that nonpunitive methods are more effective as reformatives than punitive methods. If that is so, deterrence and reformation are inconsistent ends in the sense that to the extent the one is achieved the other cannot be. If they are inconsistent, a choice must be made between them; and if the object is to prevent crime most effectively, the choice must depend on whether the use of punitive methods to deter or that of nonpunitive methods to reform has the greater preventive efficacy.

It is apparent that to prevent crime most effectively by the criminal law one needs a great deal of knowledge. One must know the etiology of criminal behavior; one must be able to distinguish between corrigible and incorrigible offenders; one must know how to reform the corrigible offender and how to deter the potential offender, and one must know the comparative preventive values of reformation and deterrence. The question is whether such knowledge is to be found in medicine in any of its branches or elsewhere. Lawyers do not believe that such knowledge exists, and they are especially doubtful that it exists in

psychiatry. They believe that radical changes in methods of treating criminals must be justified at present by ignorance and the exigent character of the problem rather than by knowledge, and that in the absence of knowledge one should proceed cautiously and experimentally. Psychiatrists can aid greatly in the formation and conduct of such experiments, but they should propose alterations in the criminal law in the tentative and truly scientific spirit which I have suggested. They should not be too impatient with lawyers for hesitating to accept and act on opinions about which physicians themselves disagree violently. And, above all, they should remember that the lawyer is concerned with other values than the prevention of crime.

## DISCUSSION

THE HON. JUDGE CORNELIUS F. COLLINS: At the outset I want to express my thanks for what the societies (New York Neurological Society, and the Section of Neurology and Psychiatry of the Academy of Medicine) have done toward the upbuilding of the psychiatric clinic in the Court of General Sessions. The court is much beholden to these societies for the professors who have been supplied to instruct the probation officers, because the ordinary schools did not give them sufficient education to allow them to render adequate service as psychiatrists. I also wish to thank the societies for the signal service they rendered in helping to straighten out the laws of New York State as they applied to commissions on insanity and in the matter of commitment of men and women to hospitals for treatment in the event that it was necessary.

I think perhaps that more progress would be made if the line of cooperation was determined. I am entirely cognizant of the fact that lawyers are sensible of a deep veneration for the medical profession and a profound respect for the administration of justice. I am equally confident of the fact that there might be some psychiatrists who would say that was as slick a way of expressing a profoundly exaggerated ego as they had ever heard. However that may be, I think that the idea which has been aimed at in recent years is to see how far psychiatry or neurology can aid the administration of justice. I think that both papers are splendid, and I do not think that the essayists are so far apart as either of them seems to think. In the first place, psychiatrists ought to classify themselves. It would be an immense aid if psychiatrists and neurologists of the state were classified by law so that the statute can follow that law, permitting only men to testify who are qualified; some of the faults found in long drawn-out trials and opinions which called forth criticism from both the legal and the medical profession could then be weeded out. The legal profession has made an effort in that direction and has tried to help the medical profession, but I find that the effort has not been successful. But that is no reason why success cannot be attained, and the facts that less time is being spent by the members of the respective professions in calling one another names and that efforts are being made by the professions to be of real practical service to one another speaks well for it.

Of course the law is a social institution. Dean Pound has defined it as "social control through the systematic application of the force of politically organized society," and that is what it is. Society must protect the personal life, security, liberty and property and right to conduct business; in other words, it must put the protecting canopy of society over one, with all the units which go collectively to make society united for that protection. A social system is needed to bring this about, and crime has to be punished. The theory of it from the legal standpoint is absolutely sound, and the physicians here will agree to that. The purpose of punishment is prevention, deterrence and reform. I do not think that what Professor Michael put forth so logically could be questioned by Dr. Glueck. He stated the primary purposes, and the aid of the medical profession is needed in carrying them out. True, the idea of prevention or of deterrence is not new, and I must insist that fear is a factor in deterrence. If a mother says to her little girl, "Look out, or Mama will spank," it has some influence, and if the father says, "Boy, another break like that from you, and you are going to hear from me," there is a



psychologic fear in that boy's mind which is beyond all question. Those fears have some effect.

Dr. Strauss will tell of a reform that has been brought about in the statutes so far as they relate to commissions on insanity and examination under 836 of the code, concerning the appointment of inquirers into insane conditions and the proper commitment of persons who are found to be insane. What else has been done? There is also the organization of clinics in connection with the Children's Court. Wonders are being performed in these clinics in the treatment of incorrigible children and of juvenile delinquents, with the help of a psychiatrist. Then there is the clinic in the Domestic Relations Court in which wonderful work is being done.

Psychiatrists are not lawyers or judges, and whenever they try to be they are poor ones; nor do lawyers pretend to be psychiatrists and to cure mental disease; they cannot. But men of both professions can be of great service to one another, and the sooner they cooperate the better. If one ever wants to convince a psychiatrist that lawyers are a lot of born fools ask him if he knows how sound in principle the McNaughton rule is. It was made by English judges and is to the effect that if an offender knows the nature and quality of his act—if he is able to distinguish between right and wrong—he is responsible. The judges did not care whether Lombroso said the shape of a man's face or the look of a man's ear had anything to do with crime or not. The legal profession is responsible to the law for the protection of society; society must be cared for, and if so, the criminal law must be regarded as a social problem and there must be rules of government and guidance for the information of lawyers and judges. There must be facts. The lawyer must follow the statutes which the members of the legislature make as deterrents to crime for the welfare of society.

The probation system is a scheme of social service established principally in the criminal courts in an effort to cope with the criminal problem and to assist in the administration of justice. Trained social workers investigate persons convicted of crime prior to sentence; they supervise the behavior of those persons whose sentence is suspended during a prescribed period of probation. This system of probation offers an opportunity to prove whether men can be reformed. The investigation is an inquiry conducted after conviction for the information of the court in determining sentence; as an aid in comprehending the social problem of the individual defendant a report is made of the details of the crime and of the defendant's personal history, particularly his general behavior and environment and his mental, moral, physical and economic conditions. Supervision over the conduct and the general behavior of the person placed on probation to note his observance of the conditions imposed by the court is, of course, necessary, and an effort is made to assist, so far as is practicable, in his care and rehabilitation in any direction necessary and actively to advise and aid him in attaining a normal social standing. All persons who are convicted in the Court of General Sessions or in any similar court are investigated after conviction. Some of these offenders are consistently bad. The way to keep a bad criminal from committing other crimes is to put him in prison and to keep him there. There are types of criminals that cannot be cured, and there is only one way of treating them. The gravity of an offender's crime determines the extent to which he will be curbed. As a matter of form an offender is examined by the physicians. They then make a report as to the degree of the offender's responsibility. A formal detailed report, pregnant with advice and guidance, is made to the court. The biologic point of view is given to the members constituting the sentencing court. It is of value. The reports cover the extent and the gravity of the crime and the medical opinion after a careful examination, which indicates the enormity of the crime and the degree of responsibility or turpitude involved in the offense, all of which aids in determining the degree of punishment to impose on the offender. The report has an influence in determining the prison to which he is sent and the length of the sentence imposed. It is a great service, because dealing with crime is a social problem; the convict will come out of prison some day and one wants not to brutalize but to reform him.



Dr. Healy's ideas must be followed in some respects; individualization in deterrence and in efforts of reform are necessary. The man must be dealt with as an individual when it is proper to do so. What does the physicians' opinion do? If a man is sent to the state's prison, a report is sent with him that gives his history from the cradle on and the report of the physicians. During the last few years and for the first time in history, these physicians have had this information concerning a prisoner long before he comes to prison, and after he arrives there vocational therapy is instituted. Of course Judge Cardozo was right when he said that social justice is greatly in the progressive stage. The physicians at the state's prison now know beforehand what it would otherwise take them years to find out. By vocational therapy and care the convict may come out of prison less potential of evil than when he went in. True, every one is potential of evil in differing degrees. Suppose that the offender is one who can be placed on probation. Suppose that she is a good girl who has gone wrong because of bad environment. This is the type of case in which good work can be done, and the probation officer must be educated so that he will know how to handle the offender.

DR. FOSTER KENNEDY: The next time I commit perjury in court I hope that I shall have sentence imposed on me by a wise and as kind a man as Judge Collins. I wonder, however, why wisdom should undergo rarefaction so markedly as one goes from Center Street to Columbia University. Professor Michael would have had more fortitude in re had he used more suavity in modo. The medical profession is not antagonistic to the law; its members are citizens and want merely to help the law. The law is an instrument of society, and as citizens physicians want that instrument keen and polished. Physicians have but little knowledge; they know what they know and also what they do not know. They are not infallible. They know that their knowledge is limited and they are anxious to avoid immodesty in members of the medical profession who are engaged to give opinions with certainty on the behalf of clients for remuneration. As a profession physicians strongly ask society to have its prisoners who are accused of crime and suspected of mental instability examined by a commission of physicians appointed by the state from major hospitals and university faculties, and paid by the state per year and not per piece. The medical profession wants to help society and the law by as much or as little knowledge as it has and it is ready to do it. The medical profession has cleaned its Augean stables in America in the last twenty-five years; the legal profession has not. I quote the leaders of the Bar Association for the past twenty years (Charles Evans Hughes, Charles Burlingame, John L. Davis and the late President Taft, among others).

The stagnation, slowness in operation and length of trials attest to this. Retribution as an instrument of society is useful if it is speedy; it is a detriment only if it is slow. Crime in this great country is permitted to happen to excess by reason of the slowness of the law. Physicians are chided here tonight for differing one with another; but I have never heard of a decision from the Supreme Court without a minority report, and if lawyers do not understand the law made by man how can the physicians understand natural law made by God? He gave them no key, but left them to find out. Of course they change their opinions. Lawyers, too, change their opinions, and perhaps would say that to improve is to change and to attain perfection is to have changed often.

JAMES G. WALLACE, ESQ.: As I came here this evening, I felt something like a psychopathic personality who was going home late one evening; he had been suffering a little from overindulgence in spirituous beverages, and as he walked along he came to a pool of water lying in the street; the moon was full, and its reflection was shining down on the water; the man stood looking down at it. A policeman came along—a normal person—and said: "Come along, my good man, go on home with you. It is 2 o'clock in the morning." And the man said: "I will, officer, if you will answer me one question." The policeman said: "What is it?" The man pointed to the pool of water; "Is that the moon down there?" "Yes, that's the moon." "Well, then, what am I doing up here?"

I do not know what I am supposed to contribute to this discussion. I am just a simple fellow who tries cases before a jury of twelve allegedly normal laymen and endeavors to persuade them of the criminal responsibility of the defendant. I have listened attentively to Dr. Glueck and, as I understand his point of view, he believes that the judgment of the jury should be dispensed with in any case in which a man's mental condition is called into question and a jury of medical experts or psychiatrists substituted for the ordinary petit jury. Of course, the law does not permit that to be done, and if it did I should question its common sense. I believe that the final question of criminal responsibility must be left to a jury of laymen. I believe that the jury ought to be guided by medical experts or psychiatrists. I should like to have the psychiatrists agree on a few things first, such as, what is a normal man? As I view it, ever since the clinic in the Court of General Sessions has been in existence every person convicted there becomes a psychopathic personality and usually suffers from amnesia, particularly with regard to his own offenses. Now, lawyers are cognizant of the fact that they ought to go further in an endeavor to enlist the services of psychiatrists and physicians generally. The American Law Institute has proposed an amendment to the law with regard to calling witnesses to testify as experts, somewhat along the lines suggested by Dr. Kennedy. That proposal is that the court shall call experts to testify to a man's mental condition when he introduces a plea of not guilty because of insanity. There is not, however, any wish to deprive the defendant of the right to call experts to give testimony, and if one goes the limit and allows the state the same privilege there will be a battle between three sets of experts, and I dare say there will be three points of view. But it does seem to me that it would not be unfair to take the privilege of calling medical experts away from the parties in controversy, and it would be an improvement for the court to call them and pay them, so that they would be nonpartisan in the delivery of their opinion.

I cannot concur with Dr. Glueck's suggestion that the question of criminal responsibility be taken away from the jury and that the sole concern of the criminal law ought to be the prisoner at the bar rather than the effect of his conduct on the rest of the community. Further, concerning the feeling or the desire that justice be done (the desire for revenge), I feel that this is so widespread among the populace that it must be considered. It seems to me that my friend, Professor Michael, is correct when he says that the first consideration must be the safety of the state, that it must be paramount and that the courts and lawyers must look to that first. If in pursuance of that course criminals can be reclaimed and reformed, if the second offender can be prevented from becoming the third and fourth offender and if the criminal population can be decreased, well and good, but the first consideration must be the safety of the state, and the safety of the state cannot be conserved if one is going to concentrate on the individual at the bar and be solely concerned with him as a possible recidivist. The law-abiding citizen must first be given assurance that offenses against him will be punished, to the end that he will not go back to a system of private vengeance, because the law as it is now is a substitute for private vengeance, and if it fails to carry out its end then private vengeance will be resorted to. That is why the criminal at the bar cannot be treated as the sole problem and consideration given only to what is going to be for his good. I do believe that there is a wider field for the employment of medical testimony and medical skill and knowledge, and particularly that kind of knowledge which has to do with mental disease, but courts cannot become clinics for the treatment of prisoners. That is not their primary function, nor can it become their primary function. It will always be a secondary consideration, and neither psychiatrists nor lawyers or judges can change that.

DR. J. RAMSAY HUNT: I think that these discussions are helpful and play a useful rôle in bringing about a better understanding between the professions of medicine and of law. In them it is possible to ventilate conflicts of opinion and differences in point of view and to find ways to reconcile such differences by practical cooperation.

When one thinks of the relation of psychiatry to law, or more specifically, the relation of psychiatry to the criminal law, one must remember that psychiatry as a body of knowledge is not very old. The profession of medicine is as old as the profession of law itself, but what is being dealt with tonight, the field of psychiatry, is a comparatively young subject in medicine. It is only within the last fifty years, or more specifically in the last thirty years, that important and sometimes crucial changes in point of view have arisen which seem to have an important bearing on criminal law.

As I ponder this subject I find that I have a divided personality. When I heard Dr. Glueck speak, the psychiatrist in me responds to his conceptions and ideals. I know what he is taking about, and I feel with him that psychiatry has its mission among criminals; they present problems in mental disorder. I feel that the ideals expressed by Dr. Glueck are the ideals of psychiatrists in general, for in every field of the medical profession ideals arise which are related to the activities of that special field. When I look at the subject as a citizen I find myself, however, seeing eye to eye with the very brilliant presentation of Professor Michael, and I think that that is the way with most every psychiatrist here. There are not many psychiatrists in the world, and as has been pointed out, they disagree as to both theories and facts. Some theories which certain psychiatrists believe in very strongly, others regard as half-baked, so how can one expect an old conservative profession like the law to be carried away by them? One certainly cannot expect this; what there is of truth and of validity as a result of these studies and investigations will gradually permeate the great public mind—the mind of the herd—and so will gradually find its way into the common law. In the end the work that is being done which is of permanent value and is on a secure basis will finally come into its own, but it may be many a year before such a thing takes place, and rightly so, for panaceas, utopias and sudden drastic changes in the criminal law might endanger the whole structure of society.

As one who has had a little experience with medical testimony, I feel that there are signal defects in the system. I think that all the lawyers admit this, but they are prone to point at necessary reasons why this should be so. There are certain constitutional rights that cannot be overridden. I am not sure that such defects in the methods of procedure are confined to the relations of medical testimony in the courts. I think that this is only a symptom of a much larger disorder which permeates the whole machinery of legal procedure in this country and which is the source of widespread criticism at the present time from both lawyers and laymen.

Of course reformation in this field will have to spring from within the law itself, although I think that so far as the problems of the medical profession are concerned considerable influence could be exerted by the presentation of the medical point of view. Some method should be found, so far as possible, to avoid such monstrosities of legal procedure as the hypothetic question and the partisan methods of expert testimony, and every effort should be made to advance and extend the practice of the appointment of an impartial commission by the court when insanity is pleaded as a defense. I think that all psychiatrists agree that the Briggs Law in Massachusetts is a great advance, and efforts should be made to extend this method of a nonpartisan report of experts in other states. And while this law does not prevent the calling of expert witnesses, both by the prosecution and by the defense, it certainly carries great weight with the jury as the report of a group of experts approved by the court.

I wish to say a word about reformation within the medical profession, because here the physician has a right to speak and should speak. That there are gross abuses in psychiatric expert testimony none will deny. There is a tendency to ascribe all these defects and abuses to the modes of legal procedure, and while this no doubt is responsible for some of the abuses in expert medical testimony, I think that one should recognize that the psychiatrist alone is responsible for others. I think that a great deal more could and should be done than has been done in

improving the nature of the testimony of physicians who appear as experts, especially psychiatrists. I see no reason, now that the time is near when every specialist in psychiatry and neurology in this country will be certified and will have to pass an examination, why there should not be a definite body of regulations for physicians who can go into court as experts. I think that it would have great influence on lawyers to know that the psychiatrists have a very high grade code of their own to which they adhere, and furthermore I am sure the lawyers would respect the psychiatrists for it; if the older and more distinguished psychiatrists adhered to this it would have a wholesome effect on the younger men who are starting in the field of psychiatry.

In conclusion, I believe that psychiatric investigations should be continued in courts, prisons and reformatories, that the offender should be studied as a sick man and that the problem should be approached from a psychiatric point of view. The psychiatrist should, however, be a realist and as a citizen understand that the law has a definite duty to perform, and he should not assert that utopia is here because of certain optimistic trends in some psychiatric fields. I think above all that psychiatrists should get together and formulate their own code governing expert testimony and should insist that it be practiced by men who are certified as specialists in this field.

ROBERT H. ELDER, ESQ.: I am inclined to agree with Professor Michael that lawyers have a great deal of trouble with physicians, but I do not believe that the physicians are altogether to blame for it. I think that the lawyers often are to blame. The physician speaks a language which is largely foreign to the lawyer. He deals with subjects that the lawyer has never studied, and although the lawyer can understand what the issue may be sometimes it is difficult for him to follow the logical processes of the physician, although they may be processes logical enough in themselves. When the lawyer cross-examines an expert witness, whether he is a psychiatrist or a general medical practitioner, he has a great deal of difficulty because he is not grounded in the criteria of judgment from which he draws his conclusions and on the basis of which he should be cross-examined if any of his errors are to be exposed. This is an unfortunate thing which comes up in almost all professions when lawyers are called on to cross-examine expert witnesses. So the suggestion that was made here tonight by somebody (I believe that it was a hint of Professor Michael's) that there be established in this city a society of physicians and lawyers who shall study medicolegal problems together was very pleasing to me. I believe that Professor Michael suggested that such societies exist in Europe. One can imagine what a problem I should have if a scholar like Dr. Glueck testified in a trial as an expert on mental conditions and gave his reasons, or if I were called on to cross-examine another expert as learned as he, thus to detect supposed error and lucidly to expose it to the jury so that they could comprehend that the expert had made a mistake or even had committed some worse blunder. I should be perplexed, yet the lawyer has that difficulty when he cross-examines all expert witnesses, whether they happen to be physicians, engineers, chemists or experts in other fields. But I do believe that when the medical expert is cross-examined, the lawyer has more difficulties than with any other kind of expert. The medical experts are those, too, who most frequently appear in court to go through this process of cross-examination.

What is to be the solution of this? I believe that in the practice of the criminal law as it is now administered there frequently come times when the lawyers have to look to men of the medical profession, whether they call themselves psychiatrists or something else, to help in the determination of fundamental facts which are absolutely essential to the administration of justice. While I agree with Judge Collins and with Professor Michael in their fundamental proposition that what is done basically is to determine the fact of responsibility, I do consider that the fact of sanity or of insanity is highly relevant to that question. That kind of evidence is relevant and material to the elucidation of that issue, so that it would be ill advised, if not impossible, to attempt to do justice without the important evidence of the physician at the trial.

At this place in administration of law, where medicine and the practice of the law touch, I think that psychiatrists and other physicians can be of great benefit to the legal profession, and therefore I regret indeed if some lawyers mistrust physicians. I do not believe that the legal profession as a whole mistrusts the medical profession as a whole. About twenty-five years ago expert medical testimony was very poorly thought of; sometimes the motives and the honesty of many expert witnesses were questioned. Sometimes witnesses testified as handwriting experts and sometimes they testified as other kinds of experts. But within twenty-five years I have observed that a great change has taken place in testimony as to handwriting, medicine and psychiatry. Physicians are now more careful in their testimony. Lawyers are more careful too in stating their questions.

I had a personal experience only a short time ago when I needed a physician as a witness in an accident case. I consulted one who had given first aid to the patient and had treated him for some time after the accident. He told me what his opinions were, what his price would be and just what he would say and what he would not say. It was to be that and nothing else, whether I retained him or whether I did not. I have a great deal of respect for a physician who lays down his principles before he is retained. I was glad to put this physician on the stand, although in some respects he testified against my side of the case. I called another physician from the Medical Center of Columbia University in that case and consulted with him before I put him on the witness stand, and he told me just what his testimony would be. The lawyers held a consultation and decided that it was wise to call him as a witness. The testimony of these physicians was so satisfactory to everybody that the opposing side did not call any medical testimony. That shows a great change, because twenty-five or thirty years ago opposing sides would have called a number of physicians.

The problem of medical testimony can be solved, and as Dr. J. Ramsay Hunt suggested there might be a list of physicians from some eminent society like these, certified as qualified and available specialists; lawyers could resort to this certified list of able physicians who could then be relied on to give true opinions and not to exaggerate the facts.

DR. ISRAEL STRAUSS: The papers of Dr. Glueck and Professor Michael were handed to me to read. I had no difficulty in following Dr. Glueck's argument. It seems to me simple and sensible. He did not say that the psychiatrist demanded much. He said merely that he had a certain view of human conduct and that the law should take it into consideration. When he came to the question of the apprehension of criminals he was following out the idea promulgated by ex-Governor Smith, although it is not original with Mr. Smith. The judge and jury determine the fact of guilt. After that is determined the question of disposition should be put before a commission consisting of specialists of different kinds—sociologists, penologists, internists, psychologists and psychiatrists—who should carefully examine the guilty person. I should include the judge who conducted the trial, because he must have formed an opinion of the man during the trial, and even the prosecutor. Such a commission should determine also the difficult question of responsibility.

I read Professor Michael's paper and enjoyed it until I came to these sentences: "Considering their differences of opinion regarding medical problems, psychiatrists display a remarkable unanimity of opinion about legal problems. I sometimes think their interest in legal matters is to be explained by their desire, which of course is wholly unconscious, to find something about which they can agree. The criminal law thus operates for them as a sort of escape mechanism." When I read that portion, I said to myself: "A professor of criminology in Columbia University is getting some insight into the unconscious!" And when he concluded his address with that story of the cartoon, "Now that I am cured, doctor, may I resume my affection for my mother?" ("Now I am through, ladies and gentlemen, may I resume my affection for the law [my mother]?") I was



still tremendously interested in this reaction of his unconscious self. I think that Professor Michael's explanation of the philosophy of the law and of retributive punishment is excellent, but I do not know where he gets the idea that psychiatrists are fighting this problem and have an unconscious desire for escape by way of an attack on the law. For three years I have been in contact with judges and lawyers, including Professor Michael, and he can vouch for the fact that we have struggled with these problems. What we are trying to do is this: I think that it is fairly well agreed that what is needed is a procedural change. In this state we have tried to provide qualified psychiatrists for medical testimony. We have brought the law to the legislature and have tried to get it passed, and the law has been made very liberal. If the law is passed, when a lawyer and the courts of law call for a psychiatrist they will know that they are getting a man qualified to go before them—a man who will understand that the psychiatrist can act not only as an accessory to the law, but can also, in a certain degree, give advice which will be in harmony with the law, one who will recognize that the law is dealing with situations with which theoretically he may not agree, but practically he must. Yet it has not been possible to get this law passed by the legislature. As Judge Cardoza said in the address which he delivered in 1929, "Don't blame judges for the McNaughton statute, because they have the idea that you cannot have an irresistible impulse; blame the legislature. They made the law which we judges have got to obey." Assisted by Judges Collins, Koenig and Nott, we have also tried to get the statute dealing with commissions changed. All that is asked in this law written by Judge Collins and approved by the Bar Association, the state medical society and the Academy of Medicine is that there shall be a commission of three people; that one of these shall be a qualified psychiatrist and the other a lawyer of five years' standing; we do not even designate the third person; he may be another physician or a lawyer or a qualified psychiatrist.

Efforts to have these bills passed have been unsuccessful. We have been to the leaders of the parties, to the chairmen of committees. We have been present at hearings. The chairman of one committee, a senator in Brooklyn, would not report out the bill on qualified psychiatrists. He thought it asked for too much. I said: "We are coming as citizens trying to improve something which we think can be bettered." I asked him if he had a general physician himself. He said, "Yes." I said, "Suppose that your child is ill, would you ask for a specialist?" He said, "I would send for a podiatrician." I said, "You don't mean that—you would send for a pediatrician!" He said, "Doctor, I studied medicine for three years, and then I studied the law." Then I knew we had not much hope.

Mr. Wallace says the court is a clinic for psychopathic personality. I can tell Mr. Wallace of cases in which the judges were in doubt as to the degree of responsibility of the criminal and in which the commission made an extensive study of the man. As a result of this study, backed by the judges, the district attorney was relieved of the necessity of trying these persons for first degree murder and accepted a plea for a lesser degree. In other words, the commissions used by the judges properly have been of great assistance to them in their disposition of cases in which there has been a question of responsibility, namely, in regard to the sanity or insanity of the offender.

Efforts will still be made to reform the law. It is hoped to combine psychiatry and the law by placing psychiatrists at the service of the law, in cooperation with judges and lawyers. Professor Michael criticizes psychiatrists. The only trouble with his criticism is that as a rule the persons whom he discussed are not psychiatrists. They are all kinds of physicians, but not psychiatrists. They should never have been qualified as such. There is no intention of conveying the feeling that physicians, psychiatrists or neuropsychiatrists want anything of the law; they are not criticizing the law; all they ask is that those things which they know are incompatible with scientific doctrines should be changed, gradually if necessary, and that psychiatrists should assist the lawyer when he is faced with problems of human nature that require the science, knowledge and experience of a psychiatrist.



DR. BERNARD SACHS: I have attended any number of meetings on this subject during the last thirty or forty years, and I think the discussion tonight has been much more fruitful than the discussion at previous meetings. I find myself in absolute agreement with Dr. Glueck, which does not always happen, and I am also happy to say that it has been a wholesome lesson to have had a lawyer and a professor of law talk as plainly as Professor Michael has done. I have not the slightest resentment over anything he said. I think that it has helped to clarify a good many of my ideas. I did not know and could not understand the legal idea that the question of criminal responsibility depended on the ability to discriminate between right and wrong. Psychiatrists feel that this is not a sufficient point of discrimination and deterrent from their point of view, but Professor Michael's presentation of the matter was so brilliant that I can for the first time agree that there are sound reasons back of this legal contention.

I was also happy to hear Judge Collins and the other gentlemen speak regarding the matter because I feel that, in addition to being a physician, one is first of all a citizen. I cannot help emphasizing that point, and I do feel that society needs protection against crime in every possible way.

There is one great distinction between the lawyer and the physician. The lawyer takes a collective view of crime, whereas the physician never goes beyond the individual, and I think that makes a great difference. I think that the point of view of the physician depends largely on his entire training. The physician is always concerned in the first instance with the welfare of the patient, so that even when he has a criminal patient he is apt to overemphasize his rights and his peculiarities as an individual, whereas the lawyer stresses the effect that the individual has on the common weal. I am therefore a strong believer in the importance of the deterrent effect of punishment. I cannot get away from this one factor in the whole question of the responsibility for crime, and if I were to do as the chairman expected me to—throw some bomb into this discussion—I should merely say this: The fear of penalty has not only a deterrent effect on the commission of crime on the part of the supposedly healthy person, but the fear of penalty has a deterrent effect also on a great many of those whom the physician would declare to be medically of unsound mind, so that I believe that the whole question of crime and the question of punishment deserve great consideration. I believe also that there is no real difference of feeling, sentiment or opinion between members of the medical profession and lawyers, and I hope that such a meeting as this will be followed by a number of others, and that the commission of which Dr. Strauss spoke will be able finally to carry its intentions into effect.

DR. WILLIAM A. WHITE: I am an ameliorist in my general tendencies, and I should like to see this meeting close on an optimistic note. I have received from the speakers a feeling of optimism and I should like to reflect it. If the program had stopped with Dr. Glueck's and Professor Michael's presentations one might easily think that the two points of view, those of the lawyer and of the physician, were so far apart that there was no possibility of their ever coming together, and yet as the different men have talked they have given expression to views which indicate that all through these years of apparent complete disharmony there have been slowly evolving improvements in the situation, so that the condition today is a great deal better than it was twenty-five or thirty years ago; forces are at work now which one has a right to expect will produce still further improvement. Man is an ingenious animal, and even if points of view are diametrically opposed it is not impossible, if he has the will, to merge these opposing points of view. Let me give an example. Suppose the whole idea of punishment in dealing with criminals should be abolished. Suppose every human being is considered a potential asset to the state, and the state takes the person who has done something which limits his usefulness and undertakes to study him to determine what is best to be done with him—what is best not only for him, but for the state—and if, after a reasonable period, it is discovered that that person is so dangerous that he should never be free, suppose he is kept under restraint. He has not been punished by intent,

and yet his confinement acts in that way; so there are two points of view which come together in actual practice.

In St. Elizabeth's Hospital in Washington there are more than 2,000 patients; a little less than half of the population is committed not by any measure recognized as legal. There is no trouble in keeping those people there while they are sick.

The two points of view that are so opposed, and which I believe can be synthesized, are these: The psychiatrist is primarily interested in the actor; the lawyer is primarily interested in the act. Those are the two objectives to which these two professions direct their attention. I do not suppose that anybody will question the right of society to say what acts it will prohibit or consider dangerous to its existence. The psychiatrist is interested only in the possibilities of helping the individual. As long as one only talks about these things one will never get anywhere; the improvement in the point of view which has been reached in the past few years has not come about just by talking. The psychiatrist and the lawyer do much more than talk. They get together, and they have been getting together for years on commissions, and when they meet to face these problems they never have any serious difficulties. Their objectives simmer down to the same thing. I have been sitting with a committee composed of members from the American Medical Association, the American Psychiatric Association and the American Bar Association. We did not have any serious disagreements in principle.

DR. BERNARD GLUECK: The story is told of a prominent Eastern university that on the law student's first contact with the law school he is told by a very impressive and learned member of the faculty that the first thing he must learn is to differentiate between law and justice, and that he must not forget he comes to the law school in order to study the law. In view of Professor Michael's opinion regarding psychiatry and psychiatrists, I leave it to the imagination what the law student must be told on these subjects. It would take another lengthy evening to do justice to Professor Michael's learned and brilliant summation of this whole question from the lawyer's point of view. I do not hesitate to acknowledge my indebtedness to him for the splendid and scholarly piece of work, but I do suspect that he does not like psychiatry.

Now, if his conception of psychiatry has been derived from the kind of psychiatry that is obliged to adjust itself to the requirements of the law through the mysterious and complex rules of evidence, or to the manipulations of the so-called "hypothetic question," I cannot blame him, but I must point out that that is not the entire scope of psychiatry by a great deal. Psychiatry is a serious piece of business in contemporary life. If it were not for its daily contributions to the amelioration and cure of certain unsocial, primitive human tendencies, one would probably be living in a world full of all kinds of troubles, including revolutions and riots. The main task of psychiatry is not the meeting of the needs created by the activities of the criminal law; its principal task has to do with the manifold irritations, conflicts and difficulties in the life of human beings, to say nothing of caring for those persons who must be segregated in special hospitals because of more profound illness.

Professor Michael is particularly annoyed by the pretentiousness of psychiatrists. He asks, "Why should the psychiatrist be more competent than the architect or the engineer in matters pertaining to the criminal law?" Well, I evidently made a mistake in not having defined psychiatry more completely. I had assumed that such a definition was not necessary in connection with this evening's discussion. Psychiatry deals with the sources, the nature, the vicissitudes and the effects of human thought and feeling and of human action and conduct. In order to be at all effective in the performance of this task, the psychiatrist must take into consideration not only the subjective, or internal, world of influence that shapes the human being but also the external world of influence that goes to shape and condition the human personality, namely, those influences which flow from the home, the school, the shop, the playground and the various institutions which

man has created for his guidance, including, of course, the institution of the criminal law. As far as the latter is concerned, I am entirely convinced after studying many hundreds of criminal careers that the chances of reformation of a given criminal are in reverse ratio to the amount of contact he has had with the law. It is for this, if for no other reason, that the psychiatrist is concerned with the functioning of the law, as indeed he is with every other institution governing man's conduct as a member of society. If Professor Michael were to read carefully any well worked-up psychiatric case study, he will find therein facts which touch on all of these human institutions and which if neglected limit the psychiatrist's capacity to understand his problem and to do something with it.

I am sorry, in conclusion, that the several specific points which I stressed in my paper were not taken up for consideration by Professor Michael. I did not mean to suggest that psychiatry offers a complete and permanent solution for this broad, complex problem of crime, but I do believe that psychiatry is capable, through its point of view and through its established technic, of bringing about partial solutions in different sectors of this problem. Surely, no progress is possible if one submits as completely as Professor Michael's arguments indicate to the tyrannies and compulsions of those shibboleths of the law which insist on a pursuit of values that have no relation whatever with the fundamental question of social security. I frankly admit that I have no interest in those values which have as their objectives the meeting of the requirements of the rules of the game, called criminal justice. There is only one value which justifies the entire procedure, and that is social security. I believe that social security with the least incidental violence to the individual should be the outstanding aim and purpose of the criminal law, and I do not believe that any good can be achieved by a backward-looking worshipfulness of the traditional precepts and theories of the criminal law.

PROF. JEROME MICHAEL: I would not say anything further were I not disturbed by some of the things which Drs. Kennedy, Strauss and Glueck have said and which indicate that some of my remarks have offended them. It is a curious thing. Dr. Glueck in his paper spoke of the infantilism and immaturity of lawyers. Now, if a psychiatrist says lawyers are infantile and immature, it is a diagnosis, but if a lawyer says something of the same sort about psychiatrists it is an insult. If I have unwittingly given offense to my friends, the psychiatrists, I am very sorry. What I said about psychiatrists and psychiatry was said in relation to the criminal law and was based on a rather extensive study of the writings and work of medical men in that field.

I have worked closely with a number of psychiatrists for whom I have the utmost respect. I have a great respect for psychiatry and an even greater respect for psychoanalysis. I think that Freud is one of the great men of all time. Indeed, it is my belief that psychiatrists have much to contribute to the solution of medico-legal problems, and my desire that lawyers and psychiatrists should work together in efforts to solve them led me to accept the invitation to address the members of these societies. My whole effort has been to clarify certain legal problems which medical men have misunderstood, because I believe that the medical man's misunderstanding of the problems which confront the lawyer is one of the chief obstacles, if not the chief obstacle, to complete cooperation between them. I think that it would be most unfortunate if one closed one's eyes to what I believe to be the unhappy relations which now obtain between psychiatrists as a group and lawyers as a group, but I never meant to suggest that lawyers as well as psychiatrists are not to be blamed for them.

If I had had more time I would have made it more explicit that what I was discussing was what I conceived to be Dr. Glueck's major proposal, namely, that criminal courts should function as social clinics for the better adjustment and rehabilitation of offenders. I insist, and I have no apology to make for this point of view because I am convinced that it is correct, that in the present state of knowledge and in the present state of public opinion that proposal is not a practicable one. The wise thing for psychiatrists to do and for lawyers to have them do at this time is to work in those fields in which they can work without arousing

the opposition of public opinion. Psychiatrists can contribute much and indeed have already contributed much to the reform of certain aspects of the administration of the criminal law. But the field in which they can now work most effectively with public approval is that of the juvenile offender. That field offers the best opportunity for experiments having reformation as their object; lawyers and psychiatrists working together in that field can accomplish two things: They can gain knowledge which is so urgently needed, and they can attack what is their second major problem, namely, the creation of a public opinion which will be sympathetic to the high purposes of the psychiatrist and which will make possible the utilization of psychiatric knowledge and technics throughout the whole range of the criminal law.

### CHICAGO NEUROLOGICAL SOCIETY

*Regular Meeting, Dec. 20, 1934*

THEODORE T. STONE, M.D., *President, in the Chair*

PRESENTATION OF A CASE. DR. JOHN D. ELLIS (by invitation).

The patient, a man, has involvement of the facial nerve and the lower four cranial nerves. Such conditions, except as a result of war injuries, are rare. As far as I know, this case is unique; none of the nerves affected is completely paralyzed. Of the various syndromes affecting these nerves, the one with which this most nearly corresponds is the syndrome of Villaret. The cases described by Villaret, however, included injury of the cervical sympathetic nerve, resulting in enophthalmos, narrowing of the palpebral fissure and miosis. My patient had some dilatation of the left pupil for the first day or so after the injury, but this soon disappeared.

Three months ago, he was struck below the left ear, approximately over the styloid process, by an iron pipe used to crank a fly-wheel. He was unconscious for a few minutes only. For the first three days he had complete loss of motor function of the facial nerve. He was unable to swallow without regurgitation into the nose, and there was difficulty in moving the tongue to the left. There was immediate paralysis of the adductor muscle of the left vocal cord. I saw the patient at the time of the accident and again three weeks ago.

When I first examined him there was paralysis of the entire facial nerve, including the muscles of the forehead. When I examined him three weeks ago he could close the left eye completely, but there were still some weakness in corrugation of the left side of the forehead and no motion in the muscles supplied by the cervicofacial branch of the left facial nerve. He still had some difficulty in swallowing, and considerable effort was required to force solid food past the middle sphincter muscle of the pharynx. There was, however, no regurgitation of food into the nasopharynx at that time. There was difficulty in coordination of the tongue, and food would stick in the left cheek and could not be extracted with the tongue. The hoarseness of voice had subsided considerably. There were never any gastro-intestinal symptoms or anything resembling the asthmatic attack that may result from injury of the vagus nerve. All facial muscles reacted to faradism. The soft palate was drawn to the right. There was no atrophy of the tongue, although there was difficulty in moving it to the right; on protrusion it deviated slightly to the left. At that time there was partial loss of taste over the posterior part of the tongue on the left; the patient was unable to distinguish a bitter taste, although he could distinguish sweet from sour. There was anesthesia of the pharynx, epiglottis and soft palate. The left arytenoid cartilage moved slightly on phonation. The right vocal cord had assumed a position somewhat to the left of the midline. He was unable to contract the upper part of the left trapezius or

sternocleidomastoid muscles, although both reacted slightly to faradism. The sternothyroid and sternohyoid muscles reacted slightly to faradism.

Roentgenograms taken by Dr. Hollis Potter did not reveal a fracture of the styloid process. A small puncture wound just over the tip of the left styloid process was entirely healed.

Since that time there has been gradual improvement in facial function and in phonation, although the voice is still husky.

#### DISCUSSION

DR. GEORGE W. HALL: I examined this patient and found definite peripheral facial paralysis and paralysis of the soft palate, both on the left side, anesthesia of the soft palate on the left and inability to taste quinine on the posterior part of the left side of the tongue. There were also paralysis of the left vocal cord, accompanied by hoarseness on talking, and paralysis of the left sternocleidomastoid and left trapezius muscles, but no paralysis or atrophy of the left side of the tongue. While many syndromes have been described similar to this, I have not encountered just this combination alone, namely, paralysis of the seventh, ninth, tenth and eleventh cranial nerves. It is more than a Jackson syndrome and more nearly resembles the so-called Vernet syndrome.

DR. LEWIS J. POLLOCK: During the World War a good many cases of the so-called Vernet, or posterior lacerated foramen, syndrome were seen, in which the ninth, tenth and eleventh nerves are injured. This injury was often the result of a missile which entered from beneath one malar bone and had its exit about the opposite mastoid. Accidental involvement of other nerves often occurred, so that as many authors' names may be found as there were variations in these cases. In addition to the posterior lacerated foramen syndrome the hypoglossal nerve is involved in many cases at the condyloid foramen, as described by Sicard. The syndrome described by Dr. Hall often occurred as a result of gunshot wounds in which a missile entered the posterior retroparotid space. In this case there is the Villaret syndrome in which the ninth, tenth, eleventh and twelfth and the sympathetic nerves are involved; in some cases the facial nerve was involved, but not in all.

TUMORS OF THE CORPUS CALLOSUM: CLINICAL AND PATHOLOGIC STUDY. DR. HAROLD C. VORIS and DR. A. W. ADSON (by invitation).

This article will appear in a later issue of the ARCHIVES.

THE DEMONSTRATION OF MYELOLYTIC SUBSTANCES IN THE URINE OF PATIENTS WITH DISSEMINATED SCLEROSIS. DR. ARTHUR WEIL and DR. JOSEPH A. LUHAN.

Previously it had been demonstrated that certain biologic products, like bile salts and snake venoms, act destructively on myelin sheaths in test tube experiments. After testing a larger group of substances, only one other metabolic product, guanidine carbonate, and the narcotic derivatives of barbituric acid could be added to this list. Following these preliminary studies an attempt was made to demonstrate such myelolytic substances in the body fluids of patients suffering from certain neurologic diseases. Specimens of urine, which were tested first, were concentrated in vacuo and incubated with spinal cords of rats for about sixteen hours. The spinal cords were embedded in paraffin, cut longitudinally and stained for myelin sheaths. A destructive action on the myelin sheaths was indicated by the formation of numerous small, black granules of myelin, while the specimen of urine from healthy persons produced only a mild swelling of the sheaths.

In 65 of 95 cases in which a clinical diagnosis of disseminated sclerosis had been made such a positive reaction was demonstrated (in 193 of 330 specimens of urine). In some of them a positive reaction was present continuously for as long as three years. In other cases the reaction became negative at intervals. In 55 of 65 such



patients the myelolytic substances could be isolated in alcoholic filtrates of the urine and could be precipitated from these filtrates by acetone. This reaction, however, was not specific for disseminated sclerosis. It was absent in specimens of urine from normal persons, in cases of subacute combined degeneration of the spinal cord, in cases of arteriosclerosis of the brain and in cases of syphilis, tumor and trauma of the central nervous system. It was positive in 18 of 22 cases of postencephalitic parkinsonism (23 of 35 specimens of urine), in cases of hepatic disease and in 2 cases of pulmonary tuberculosis.

## DISCUSSION

DR. G. B. HASSIN: A widespread opinion among general pathologists and neuropathologists is that multiple sclerosis is an inflammatory disease process, regardless of the fact that the changes in this morbid condition are typically degenerative and probably caused by some toxins. The exact nature of the toxins is not known, but would not Dr. Weil consider that his investigations, as well as those of Brickner and others as to the presence in the blood of patients with multiple sclerosis of abnormal ferments and other substances harmful to the myelin, speak for the "degenerative" rather than for the "inflammatory" nature of multiple sclerosis?

DR. CLARENCE A. NEYMANN: If one takes ordinary heart tissue that has been artificially dried and extracts this first with ether and second with alcohol and then precipitates the alcoholic extract with acetone, one obtains a group of substances known as aminophosphatides. These phosphatides are commonly used as antigens in the Wassermann test. They can be prepared not only from heart tissue but also from muscle, liver, Katsuwobuchi (Japanese dried fish) and leather and even from wheat. These substances show a great physical and chemical affinity for the other lipoids. They form loose chemical combinations with lipoids and fat, especially with such lipoids as cephalin and lecithin. I wish to ask Dr. Weil whether he has taken specimens of normal urine, concentrated them under reduced pressure without increasing the temperature, extracted them with alcohol, precipitated the extract with acetone and then made an emulsion of the resultant residue with physiologic solution of sodium chloride and exposed his rat preparations to this?

A series of patients with multiple sclerosis has been treated by me with electropyræxia. About 84 per cent of the patients showed remissions during the period of treatment. In 140 cases reported by Sachs in which the patients had been observed for a period of ten years there was an incidence of remission of 40 per cent. The remissions in my series (incidence of 84 per cent) occurred within three months and have been maintained up to the present time, a minimum period of eighteen months and a maximum period of three years for some of them. How does Dr. Weil explain these results in terms of his lipase theory?

DR. ARTHUR WEIL: I should be glad if I could answer Dr. Hassin in the affirmative, but I hesitate because I do not yet feel inclined to draw the final conclusion that these myelolytic substances eliminated with the urine are the etiologic factor in cases of disseminated sclerosis. It may be that their presence and the simultaneous increase in blood lipase are only the indicators of some other disease of some other organ (liver?) which is not understood. If one should draw the final conclusion as to the relationship between these myelolytic substances and the process of demyelination in cases of disseminated sclerosis, then one could state that this disease is a primary degenerative process. The substances eliminated with the urine in cases of disseminated sclerosis do not act like ferments. They are soluble in alcohol and are heat-resistant, and it is not likely that they are the same lipolytic substances which Brickner demonstrated in the blood or the blood lipase which Crandall and Cherry demonstrated.

In answer to Dr. Neymann, the acetone precipitates prepared from specimens of urine do not contain phospholipids because they do not contain phosphorus. They contain a high amount of nitrogen and give a strongly positive reaction for



urobilin and methylguanidine, indicating some disturbance of hepatic function. Of course, I made the same tests with specimens of normal urine, prepared acetone precipitates and incubated the solution of the precipitates with spinal cords of rats, with negative results. In one of the lantern slides which was shown, the action of precipitates of specimens of urine from normal persons and from persons with disseminated sclerosis were demonstrated together. I do not know anything about the relationship between hyperpyrexia and the increase or decrease of lipase in the blood.

THE POSSIBLE RELATION OF LEAD INTOXICATION TO MULTIPLE SCLEROSIS. DR. BENJAMIN BOSHES (by invitation).

This article will appear in a later issue of the ARCHIVES.

### NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY

LEON H. CORNWALL, M.D., *Secretary*

*Dec, 11, 1934*

C. BURNS CRAIG, M.D., *Chairman, Presiding*

VISUAL DISTURBANCES FOLLOWING CARBON MONOXIDE POISONING. DR. MILTON ABELES, New York (by invitation).

The patient, a high school student aged 15 years, on Nov. 11, 1933, was accidentally overcome by illuminating gas to which he had been exposed in a closed bathroom for approximately one hour. Within a short while he became restless and began tossing about and kicking. Four hours after the exposure he was admitted to the Bellevue Psychiatric Hospital. On admission, he was tossing about wildly, making gross purposeless movements of the extremities; he was difficult to control and was groaning. He did not talk, and no contact was possible. The skin and mucous membranes were pink. The respiratory rate was 32 per minute. The heart, lungs, abdomen and extremities were normal. The blood pressure was 132 systolic and 88 diastolic.

Neurologic examination showed that the pupils varied from time to time in size and reaction; sometimes they were dilated and equal, and at other times, unequal. At times they were fixed or sluggish to light; sometimes one reacted and sometimes both. The corneal reflexes were absent. There were alternating flaccidity and spasticity of the upper extremities. The biceps and triceps reflexes were depressed, and the upper limbs were apparently paralyzed. The reflexes in the lower extremities varied but were usually active and equal. The superficial reflexes were present. There were bilateral Babinski and Chaddock signs. There was moderate rigidity of the neck with a bilateral Kernig sign.

The spinal fluid was clear, with no cells or globulin; the colloidal gold curve was flat. Serologic tests with the blood and spinal fluid gave negative results. The urine was normal except for a trace of albumin and 1 per cent sugar, both of which soon disappeared and were not again found. The blood count revealed 11,800 white cells, 90 per cent polymorphonuclear leukocytes and 5,100,000 red cells. The chemistry of the blood was normal. Carbon monoxide was found in the blood; at one time there was 3.8 per cent, and at another time, 6.5 per cent.

The patient's condition remained unchanged for about three weeks. At times he would lie quietly in bed with the eyes shut as though sleeping. At other times, without apparent provocation, he would make noisy cries and groans and would thrash about in a wild and restless fashion, at times throwing himself out of bed. He never spoke and was resistive to examination. He rarely took any-

thing by mouth and had to be fed by tube regularly. There was incontinence of urine and feces. For three weeks the temperature was irregular, ranging as high as 104 F.

Toward the end of the second week the patient seemed brighter and was less restless, and the periods of quiet were longer. In the third week the patient's eyes followed the movements of the examiner. He was also able to get out of bed, to walk and to take all nourishment by mouth voraciously. He began to show pathologic crying, a sucking reflex and athetotic and dystonic movements and postures of the hands, which were more marked on the right. There was some spasticity in the upper extremities; speech was monotonous, and the facies were fixed. Orientation was poor, and memory showed defects.

The most remarkable findings were the visual disturbances. The patient had marked difficulty in perceiving his environment. He could not find his way about the wards, for instance, to the bathroom, even after he had been shown. He did not recognize by sight any one who attended him and called all men "daddy" and all women "mama" but explained that they were not his real parents. Although he apparently could perceive lights of much different intensities, he could not recognize large objects such as chairs. He could not describe his environment. When asked the size of the room he was in, he said: "I have not a bit of an idea." He could not find his way about it. He could not tell how many people were in the room. He bumped into things in his progress. He could discern motion, especially gross movements. When asked if he was blind, he denied it emphatically and said that things looked clear to him.

In contrast to the inability to recognize forms, he soon began to name colors correctly. Though in the beginning, owing possibly to easy fatigability, he made mistakes, as he improved there was a definite dissociation of form and color perception. When shown a dollar bill, he said that it was a key (he frequently guessed), but he named the color correctly. Even with smaller objects—he was shown different colored pencils—he named the color correctly but was at a loss for the name of the object. He could name any of the objects if allowed to handle them. Little could be done in the way of accurate field studies in the beginning. Also, he could describe the direction of a moving object, but he was not sure of the angle at which a straight object might be held.

Since discharge from the hospital a year ago he has gradually improved. Perception of color has become accurate, but he has little conception of shape or form. Judgment of depth and distance is not always accurate, though these tests are not completely conclusive because in pointing tests dyskinesias, which still persist, interfere. The visual fields, as far as can be tested at present, are concentrically constricted for light and colors. The patient apparently has only central vision.

When asked to imitate simple formations made with tongue depressors and bent wires he frequently fails. When shown large letters he makes mistakes, but if he traces them with his finger he more frequently names them correctly. He sometimes imitates movements better after he closes his eyes. He shows evident alexia. He can write now but cannot read his own writing. When shown pictures he seems to recognize parts of them, but he cannot describe any unusual forms in them.

Psychometric examinations show that the patient has suffered a general lowering of intellectual efficiency, represented quantitatively at present as a mental age of 8 years. Scatter on the Binet test ranges from the third to the sixteenth years.

This case is similar to the case reported by Wechsler last year and another reported by Grimsdale this year, in both of which perception of color was much better than perception of form following carbon monoxide intoxication. These cases indicate that there is probably separate localization in the brain for color and form and that the recognition of form may be lost and color vision preserved.

It also raises the question of the localization of color perception and the gnostic center of color. It is most probable that color is perceived in the more superficial layers of the calcarine cortex and that the gnostic center for color is in the adjacent cortex, probably about the fusiform and the lingual gyrus.

That the effect of carbon monoxide is not specific for the color-perceiving elements is demonstrated by 3 other cases which I had the opportunity to observe following carbon monoxide poisoning. In these cases there was marked impairment of color perception.

## DISCUSSION

DR. BERNARD SACHS: Did the patient have any involvement of speech?

DR. MILTON ABELES: Speech was good. In the beginning there was a questionable aphasic disturbance, but nothing outstanding.

DR. ISRAEL S. WECHSLER: Apparently the conception that color perception is always lost first and regained last in cases of visual disturbances is not altogether true. The case presented by Dr. Abeles is the third that has come to my attention; I presented one at a meeting of the Academy and recently I received the report of another. It is probable that this type of dissociation is not uncommon, and the dictum that color vision is lost when vision is lost does not always hold. The questions arise: Do these patients have actual loss of vision or is there involvement of a higher gnostic center? Do the disturbances of vision belong in the group of aphasia rather than in vision itself? None of the patients of whom I have read and whom I have seen have had disturbances of visual perception. The geniculate bodies and corpora quadrigemina are not affected, apparently, and the calcarine area seems normal. Therefore, it is possible that this is an aphasic disturbance—a higher symbolic disturbance—rather than a true disturbance of vision. The opposite findings are much more common. Achromatopsia, or hemichromatopsia, with good vision for form, is much more frequent. Another point is that carbon monoxide also has selective affinity for the cortex, although it is usually said that it has special affinity for the basal ganglia and peripheral nerves. Although in general it is perhaps true that the basal ganglia are more susceptible, no part of the brain escapes the effects of carbon monoxide.

## CHARCOT-MARIE-TOOTH DISEASE WITH OPTIC ATROPHY. DR. DANIEL E. SCHNEIDER, New York (by invitation).

Two patients, brothers, are presented because they illustrate an unusual combination of optic atrophy with the Charcot-Marie-Tooth syndrome. Members of the preceding generations on both the paternal and the maternal side, previous to the immediate family, could not be examined, although it was reported that one paternal aunt had had "very thin legs." The members of the immediate family were normal. The family comprised five siblings, one of whom died at the age of 21 in childbirth. The others, except for the patients, were normal. The ages of the patients are 41 and 26, respectively. The father drank excessively at the time of the conception of these two boys, with periods of temperance at the time of the conception of the other children. The older brother, in addition to the physical findings, is definitely of a psychopathic nature. He has drunk heavily since the age of 17. The younger brother does not drink alcohol. In both patients the condition ran a similar course. Ocular trouble was discovered when they were from 5 to 7 years of age; both began to limp early in the second decade of life, the right leg becoming "lame," with progressive weakness of both lower extremities.

The younger brother, who did not drink alcohol, entered the clinic only by request for examination. The elder brother was admitted to the hospital twice for alcoholism, and at the time of the preparation of this abstract he is again in the hospital for alcoholism.

Both patients show essentially the same positive findings. Those referable to the cranial nerves were bilateral primary optic atrophy, with peripapillary choroidal

changes; vision of 1/100 in both eyes without glasses and no improvement with glasses, and nystagmoid movements of the eyes on convergence (with horizontal and lateral oscillations also). The symptoms referable to the motor system were absence to marked diminution of the triceps and periosteal reflexes in the upper extremities, with intrinsic atrophy of the interosseus muscles and forearm bilaterally; absence of reflexes in the lower extremities; bilateral drop foot; atrophy of all the muscle groups of the calves, most marked in the peroneal region, with complete paralysis of dorsiflexion; slight athetoid movements of the fingers, with flexion in the basic phalanges of all the fingers and also in the distal phalanges of the right ring finger and the little finger; no fibrillations; waddling gait, with bilateral steppage, and a slight tendency to genu recurvatum. The symptoms referable to the sensory system were marked disturbance due to involvement of the posterior portion of the spinal column, with mild diminution for pain and touch sensation in glove and stocking distribution over all four extremities; loss of position sense in the toes and marked diminution in the fingers; bilateral dystereognosis, with loss of two point discrimination, and fair coordination.

The younger brother did not complain of any progression of symptoms. The elder said that he felt he was getting weaker.

*Comment.*—It is forty-eight years since the Charcot-Marie-Tooth syndrome was described. Krause, in 1906, reported 5 cases which had showed primary optic atrophy. Since 1906, a few cases have been described with mild changes in the disks, such as temporal pallor, but rarely with complete optic atrophy.

#### DISCUSSION

DR. BERNARD SACHS: In 1890 I published in *Brain* the first paper on peroneal progressive muscular atrophy in the United States. The symptoms were similar to those reported here. I am sorry that Dr. Schneider did not show a view of the posterior surface of the legs because it presents the characteristic appearance of the leg, with absolute flatness, which distinguishes these cases of atrophy from other types. I have not seen cases of the Charcot-Marie-Tooth syndrome with optic atrophy. I wish to ask whether such cases are not distinctly due to alcoholism. It is supposed, and I presume it is correct, that cases of the Charcot-Marie-Tooth type are due to involvement of the peripheral nervous system rather than to a disorder of the central nervous system. In my cases several members of the family were affected; the boys at that time were aged 14 and 12. I think that the majority of cases reported have occurred at an early age.

DR. DANIEL E. SCHNEIDER: In the 5 cases reported by Krause, alcoholism was not considered an important factor. In the 2 cases reported here, 1 patient drank and the other had never touched alcohol. Furthermore, in both the diminution of vision, which was marked, began at the age of 5. Both patients showed nystagmus. This rules out alcoholism as a primary factor in the etiology of the optic atrophy.

#### ENCEPHALITIS COMPLICATING PNEUMONOCOCCUS. DR. IRVING J. SANDS, Brooklyn.

R. G. S., a single man, aged 28, was admitted to the Brooklyn Hospital on March 27, 1933, and died on May 14. The family and the personal history are without significance. The patient at the time said that he worked as a reader of gas meters. Twelve weeks prior to admission he had pain in the epigastrium, which was aggravated by respiration and accompanied by low grade fever. The condition was diagnosed as diaphragmatic pleurisy. A week later signs pointed to congestion in the lower lobe of the right lung, with elevation of temperature to 103 F. A friction rub appeared over the pericardium and lasted for one week. At that time the urine contained red blood cells and albumin. The patient progressed well until March 21, when he began to complain of frontal headache, which was aggravated by moving the head and relieved by absolute rest. He began

to vomit on March 23. The headache and vomiting persisted, and he was sent to the hospital.

On admission the patient was emaciated. There were moderate nuchal rigidity and a mild Kernig sign. The margins of the disks were slightly blurred, and the veins were engorged. The deep reflexes in the upper extremities were depressed; they were lively in the lower extremities. No pathologic reflexes were found. A systolic murmur was present at the apex. The lungs were apparently normal. Mentally, the patient was drowsy and somewhat apathetic and yet cooperative. The temperature was 102 F.; the pulse rate, 96, and the respiratory rate, 20.

The urine was alkaline and the specific gravity, 1.018; there were albumin and a few red blood cells. The blood count showed 8,690 white cells with 81 per cent polymorphonuclear leukocytes, and 2,980,000 red cells, with 45 per cent hemoglobin. The blood chemistry was as follows: sugar, 95 mg. per hundred cubic centimeters; creatinine, 2.3 mg.; urea nitrogen, 32.3 mg.; uric acid, 9 mg., and carbon-dioxide-combining power, 36.1 cc. The Wassermann and Kahn reactions of the blood were negative. Blood cultures were sterile. The spinal fluid was clear, was under a pressure of 150 mm. of water and contained 240 cells, almost all lymphocytes; the total protein content was 28 mg. and the sugar content, 65 mg. There were no organisms on smear or culture. The Wassermann and Kahn reactions were negative. There was no reduction in the colloidal gold curve.

Roentgenograms of the chest revealed mottling of both lungs, more on the left, and the general picture suggested the presence of miliary tuberculosis. A tentative diagnosis of tuberculous meningitis complicating pulmonary miliary tuberculosis was therefore made.

The patient continued in a drowsy and apathetic state, and grew very weak. The temperature rose to 103 F.; speech became rather thick and indistinct. The right pupil became larger than the left, and there was some weakness of the left upper extremity. The left plantar reflex was lost. Signs of meningeal irritation increased. In the second week the temperature declined to 101 F., but the patient showed drowsiness and increasing weakness. On April 5, there appeared weakness of the left upper extremity and paralysis of the left external rectus muscle. A supranuclear facial weakness on the left side developed. The tongue protruded to the left. The nuchal rigidity and the Kernig sign were increasing. The breath sounds were impaired at the base of the left lung. The spinal fluid contained 120 lymphocytes, with a sugar content of 72 mg. and a chloride content of 810 mg. No organisms were found on smear or culture.

The mental condition of the patient was characterized by apparent drowsiness and apathy, and yet he was readily cooperative, passed comments on what went on in the wards and seemed to be facetious at times. He did not have the apprehension or restlessness common in cases of tuberculous meningitis. A diagnosis of encephalitis was ventured, particularly in view of the condition of the spinal fluid. On April 18 convulsive movements of the left side of the mouth and of the left upper extremity suddenly developed, and there was flaccid hemiplegia on the left side. The patient complained of headache and vomited. Though drowsy, he was definitely facetious and cooperated well. The possibility of a tuberculoma or a metastatic tumor of the brain was considered. Encephalography was carried out, 120 cc. of fluid being replaced by air. The encephalogram was normal.

It was then decided that the case was one of encephalitis; six intravenous injections of typhoid vaccine were given, followed by chills with elevation of temperature to 103 F. The patient improved considerably, and the paralysis gradually disappeared. Repeated roentgenographic studies of the lung gave identical pictures which were reported as those of miliary pulmonary tuberculosis. The spinal fluid was injected into several guinea-pigs; tuberculous lesions were not found at autopsy. It then became apparent that it was unusual for the patient to have pulmonary miliary tuberculosis in an active stage without showing more striking pulmonary signs or some evidence of spread of the process on the x-ray plates. An electrocardiogram was normal, and repeated blood cultures were negative.



On May 10 the condition was greatly improved, and on May 11 the patient was allowed to get out of bed. I interviewed him on that day. He was facetious and was particularly evasive about his occupation. He finally admitted that he had been working for the gas company only for the past eighteen months and that he had been previously employed for ten years by one company in polishing plaster of paris models. He would hold the casts over revolving brushes, and considerable dust was caused by this process. He felt hurt at being discharged from the position that he had held for ten years and therefore would not talk of his previous work. The picture then became relatively clear, and a diagnosis of encephalitis complicating pneumoconiosis was made.

On May 13 the patient suddenly had a chill; the temperature rose to 103 F., and on examination signs pointed to confluent bronchopneumonia. He died on May 14.

Necropsy disclosed: extensive encephalitis, extensive pneumoconiosis, chronic pleuritis, subacute and chronic glomerulonephritis, chronic fibrous pericarditis and terminal confluent bronchopneumonia.

#### DISCUSSION

DR. C. BURNS CRAIG: Does Dr. Sands imply that there was a causative association between the pneumoconiosis and the encephalitis.

DR. IRVING J. SANDS, Brooklyn: There is no connection between the pneumoconiosis and the encephalitis; their coexistence was a coincidence which made diagnosis difficult. The man had probably had influenzal pneumonia in 1932, and I think that may have predisposed him to the encephalitic process. The case was simply one of encephalitis occurring in a person with pneumoconiosis, just as encephalitis may occur in a person with a fractured or an amputated leg.

#### ESTERASE PROPERTIES OF THE BLOOD IN CASES OF MULTIPLE SCLEROSIS: THEIR USE IN DETERMINING PRESUMPTIVE ACTIVITY OF THE DISEASE. DR. RICHARD M. BRICKNER, New York.

Many of the qualities of the esterases have general physiologic and pathologic connotations; this presentation is limited to a statement of some of their characteristics in cases of multiple sclerosis. Any case of multiple sclerosis in which at least one new symptom appears within four months of the blood test, and in which that symptom does not improve, is considered to show a minimal degree of activity. A case is considered inactive when no new symptoms develop within four months or when all symptoms are improving.

The results of the experiments were: During activity of the disease, serum esterases are normal in their degree of action; during inactivity of the disease the action of the esterases rises to a level considerably above normal. The data are derived from study of 62 cases—47 active and 15 inactive cases. The facts are sufficiently striking to warrant the statement that activity of the disease is incompatible with an esterase value above a certain level. In addition, the experiments show that the presence of a small amount of quinine hydrochloride in the flask containing the serum and ester stimulates the action of the esterase. Thus, experimental support for the administration of quinine in cases of multiple sclerosis is obtained. Experiments are now under way in which patients are being studied both before and after treatment with quinine. A sufficient number of these has not been done, to date, to warrant a report.

#### A SEROLOGIC COMPLEMENT-FIXATION TEST FOR MULTIPLE SCLEROSIS. DR. GABRIEL STEINER (Department of Psychiatry and Neurology, Heidelberg University, by invitation).

If multiple sclerosis is a morbid entity and in particular an infectious disease of the nervous system, it follows logically that an antigen-antibody reaction must be sought. This requires the cooperation of a neuropathologist and a serologist.



The work was undertaken with Dr. Sachs, serologist at Heidelberg University. The brains and spinal cords of patients with multiple sclerosis were chosen as the antigen. This material, however, was available only after fixation in solution of formaldehyde. The work was begun in November 1931. In January 1934 a fresh brain became available and proved to be a better antigen.

The method was similar to that of the Wassermann test. The blood of the patient was the antibody, the guinea-pig serum, the complement, and the antisheep cell system, the indicator. Brain and spinal cords that had been fixed in formalde-

TABLE 1.—*Complement Fixation on Reaction of Extract and Patient's Serum, with Clinical Diagnosis \**

	A Multiple Sclerosis	B Stomach Disorder	C Primary Syphilis	D Latent Syphilis	E Dermatitis	F Headache
I. Extract of multiple sclerotic brains						
1:10.....	++++	++++	++++	+++	—	—
1:15.....	++++	+++	—	++	—	—
1:20.....	++++	+++	—	++	—	—
1:40.....	++++	+	—	++	—	—
1:80.....						
II. Extract of arteriosclerotic brains						
1:10.....	—	++++	++++	++++	++++	—
1:15.....	—	++++	++++	++++	++++	—
1:20.....	—	+++	++++	+++	++++	—
1:40.....	—	+	—	+++	++++	—
1:80.....	—	—	—	++++	++++	—
III. Extract of beef heart (Wassermann reaction)....	—	—	—	++++	++++	++++

\* Amounts (0.1 cc.) of progressive dilutions of (I) extract of multiple sclerotic brains diluted to 1:10, (II) extracts of arteriosclerotic brains diluted to 1:10 and (III) cholesterolized beef heart extracts diluted to 1:6 are mixed with 0.1 cc. amounts of various test serums (A-F) diluted to 1:5. These are kept in the incubator at 37 C. for one hour; 0.2 cc. of an equal mixture of washed red blood cells of sheep and antired blood cell amboceptor (hemolytic system) is then added to each. ++++ indicates complete inhibition of hemolysis; +++, almost complete inhibition of hemolysis; ++, moderate inhibition of hemolysis; +, slight inhibition of hemolysis, and —, complete hemolysis.

TABLE 2.—*Results of Additional Confirmatory Tests*

Result	289 Definite Cases of Multiple Sclerosis	1,340 Controls	
Positive	120 = 41.52%	41 = 3.06%	
Doubtful	10 = 3.47%	8 = 0.6%	
Negative	159 = 55.01%	1,291 = 96.34%	
	173 Doubtful Cases of Multiple Sclerosis	110 Cases of Other Diseases of the Central Nervous System	1,057 Other Controls
Positive	32 = 18.5%	4 = 3.63%	5 = 0.47%
Doubtful	8 = 4.62%		
Negative	133 = 76.88%	106 = 96.37%	1,052 = 99.53%

hyde were washed with running water for twenty-four hours and cut into small pieces. For extraction, 5 cc. of 96 per cent alcohol was used for each grain of brain and spinal cord. The brain extract was fractionally diluted with physiologic solution of sodium chloride. Brains (fixed in formaldehyde) from persons with other conditions (dementia paralytica, arteriosclerosis and schizophrenia) were prepared in the same manner and used as controls.

The reaction was considered positive only when there was complement fixation with the extract of brains of patients with multiple sclerosis and not with the extract of the brains of persons with other conditions. Additional confirmatory tests were made, such as tests for lecithin precipitation and the blood sedimentation rate. Results are given in table 2.

The control material has been divided into three groups: (1) the blood from patients brought to the Serological Institute with a doubtful diagnosis of multiple sclerosis; (2) the blood of patients with other nervous diseases (epilepsy, syringomyelia, tumor of the brain, neurosyphilis, postencephalitic parkinsonism, combined posterolateral sclerosis, chorea, spondylitis, cerebral arteriosclerosis, migraine, Ménière's syndrome, schizophrenia, psychopathic conditions and neurosis), the reaction being negative in 106 cases and positive in 4 cases (once each in a case of

TABLE 3.—*Data in Cases in Which a Definite Diagnosis of Multiple Sclerosis Was Made*

I. Age	Percentage of Positive Reactions
17-22.....	83.75
23-28.....	66.66
29-34.....	50.0
35-40.....	56.66
41-46.....	50.5
47 and over.....	28.57
II. Duration of the multiple sclerosis	
Months-2 years.....	76.6
3-5 years.....	58.82
6-10 years.....	61.22
11-15 years.....	45.0
16-20 years.....	44.5
21 and over years.....	20.0
III. Clinical state	
Exacerbation.....	78.72
Remission.....	12.5
Chronic-stationary.....	31.37

TABLE 4.—*Data for Serum of the Same Patients at Different Stages of the Disease*

Patient	Date of Blood Sample	Serologic Result	Clinical Condition
Fra.....	9/17/31	Positive	Exacerbation
	1/23/31	Positive	Exacerbation
	10/3/32	Positive	Beginning remission
	1/2/33	Doubtful	Complete remission
Re.....	9/22/32	Positive	Severe exacerbation
	10/25/32	Weakly positive	Mild improvement
	2/17/33	Negative	Incomplete remission
Za.....	2/17/32	Positive	Severe exacerbation
	12/14/32	Negative	Good remission
Ka.....	8/3/32	Positive	Definite but not severe exacerbation
	10/21/32	Negative	Good remission
Fl.....	12/21/31	Positive	Fairly severe exacerbation
	12/2/32	Positive	Remission
	10/30/34	Negative	Very good remission

epilepsy, hereditary ataxia, syringomyelia and recurrent myelitis), and (3) the serums of patients with a variety of internal, non-nervous disease, only 5 reactions being positive—1 case each of primary syphilis, gonorrhea, eczema, deafness and of an undiagnosed condition.

The cases in which a definite diagnosis of multiple sclerosis was established, with the available data, were arranged according to age and to the duration and stage of the disease, and the percentage of positive reactions was noted (table 3).

Serum from the same patients has been tested at different stages of the disease, but only in a few cases. The results are given in table 4.

The spinal fluid was examined in a few cases. The reaction was positive in 3 out of 16 spinal fluids of patients with definite cases of multiple sclerosis. The blood serum in these 3 cases was negative. In 1 of 9 doubtful cases of multiple sclerosis the reaction was positive. The reaction of 51 specimens of spinal fluids from patients with nonmultiple sclerosis was never positive.

THE PATHOGENESIS OF MULTIPLE SCLEROSIS. DR. TRACY J. PUTNAM (Department of Neurology, Harvard University, by invitation).

It is generally admitted at present that the lesions of multiple sclerosis pass through an evolution from a stage of acute degeneration to the final glial scar. There is much dispute, however, as to whether or not the acute stage represents fundamentally the same histologic process as that in certain forms of "acute disseminated encephalomyelitis," which has at least a certain gross similarity with it in some instances. Three chief differences between the two have been pointed out. The first is that the lesions of the acute disease do not display the smooth outline and complete lack of myelin of those of multiple sclerosis. It is, however, possible to find sclerotic plaques, especially in the cerebrum, where they occur in their purest and simplest form, with wavy, hazy outlines and many remnants of myelin entirely comparable with those of "encephalomyelitis." A second point of difference is often held to be the intense gliosis of the sclerotic plaque. Careful comparison of the density of the scarring in this disease with that in areas of secondary degeneration of similar age shows the process to be essentially similar both qualitatively and quantitatively in the two instances. The gliosis may therefore be regarded as reactive. A third difference which has been emphasized is the degeneration of axis-cylinders in cases of "encephalomyelitis." Many cases of multiple sclerosis have been reported, however, in which entirely similar areas of complete degeneration have been found side by side with typical sclerotic plaques with preserved axons. The coexistence of both types of lesions is probably far commoner than is usually emphasized. Both have been found in the majority of cases of multiple sclerosis in which it has been possible to carry out complete histologic studies in the laboratories of the Neurological Unit.

To turn to direct evidence, Kramer and also Schlesinger have published reports of typical cases of encephalitis in association with measles with survival for several months in which autopsy revealed sclerotic plaques with preserved axons. Experimentally, it has been possible to produce both types of lesion in animals by the administration of tetanus toxin.

Even if one assumes "disseminated encephalomyelitis" to be an acute form of multiple sclerosis, the problem of the pathogenesis of the former disease remains. There exists fragmentary evidence that anoxemia, perhaps of a special form, may produce the histologic picture of focal demyelination with relatively slight loss of axons. It occurs about thrombi in the white matter in cases of carbon monoxide poisoning. Ferraro has produced it in animals by cyanide poisoning. Kubik has recorded a case in which a similar picture resulted from prolonged exposure to a mixture of nitrous oxide and oxygen. Venous thromboses have been observed in many cases of "encephalomyelitis."

Direct experiment confirms this hypothesis. Arterial embolism produces areas in which axons are damaged to a greater or less extent but always less than the myelin sheaths. If, however, the circulation is obstructed from the venous side by the injection of a viscous mass between ligatures upstream into the longitudinal sinus, areas of loss of myelin occur in which the axons remain practically intact and in which gliosis occurs in the course of months.

Turning once more to the pathologic process in cases of multiple sclerosis in human beings, one finds that unmistakable fibrinous and hyaline thrombi may be demonstrated with considerable frequency by the use of appropriate stains. They have repeatedly been described even in the nineteenth century. In addition, there is evidence that some vessels have been converted into fibrous cords without lumens and that thrombi have become canalized in others. A secondary proliferation of

vessels may occur, and this probably explains the "contoured" or concentric lesions occasionally encountered. Further study is in progress along these lines.

If thromboses occur without local abnormality, some abnormality in the coagulability of the blood should be demonstrable. Solomon and Simon have shown that the clotting time in patients with multiple sclerosis may be within normal limits under ordinary conditions, but that in the majority of instances it is much more affected by the administration of epinephrine or of typhoid vaccine than is the case with control subjects.

CLINICAL SPECTROSCOPY: METALLIC RETENTION AS A QUANTITATIVE VARIANT IN DISEASES OF THE NERVOUS SYSTEM, WITH BIOSPECTROMETRIC OBSERVATIONS IN TWO HUNDRED AND FORTY-NINE CASES. DR. L. EDWARD GAUL, A. H. STAUB, B.S., AND DR. ROLLO MASSELINK, New York (by invitation).

Clinical spectroscopy is a new method of attack in biologic research. This method has supplanted the usual analytic procedures by an instrument that gives both qualitative and quantitative data in one analysis—namely, the spectrograph. The analysis of connective tissue for metallic constituents furnishes data of more clinical significance than the usual analysis of excretory products for the toxic metals. As a means of identifying this test we coined the word "biospectrometric." By this we designate a qualitative and quantitative analysis for the metallic constituents in differentiated and undifferentiated mesoderm. The dermal biopsy specimen is obtained with a 0.47 cm. punch and weighs approximately 0.025 Gm.

The actual perspective of a biospectrometric analysis was visualized after a series of biopsy specimens were obtained from patients who had received varying doses of gold sodium thiosulphate for lupus erythematosus. These findings, which were reported, established that the quantity of gold present in the biopsy specimens was directly proportional to the total dosage administered and was permanently fixed in connective tissue. Antemortem analysis showing the quantity of gold in a biopsy specimen and subsequent postmortem analyses of approximately equal amounts in all tissues and organs established a uniform quantitative distribution throughout the body. After completing identical studies on silver and lead we were able to conclude that a biospectrometric analysis would determine the qualitative and the quantitative retention of metals by the body.

A biospectrometric analysis in a typical case of psoriasis proved startling, since nickel was found in a relatively large quantity (0.00009 Gm.). Analyses in 45 additional cases established the retention of nickel as a quantitative variant. It occurs in approximately 6 per cent of apparently normal dermal biopsy specimens, but the quantity present is always less than the minimum quantity (0.00001 Gm.) found in cases of psoriasis. In 40 cases of so-called chronic eczema there was present a marked retention of copper. Serum collected from weeping lesions likewise showed a large amount of copper. Recently we reported 65 cases of generalized argyrosis following organic and colloidal silver medication (mild silver protein, neosilvol and silver arsphenamine), which included biospectrometric analyses in 10 cases. It was established that argyria became clinically apparent after a silver retention approximating an equivalent of 8 Gm. of silver arsphenamine. Knowing the hazard of inducing argyrosis from silver arsphenamine, the syphilologist can now determine the amount of silver retention before instituting therapy, thereby obviating the possibility of producing a therapeutic argyrosis.

Three fundamental factors will be considered in this report: the meaning of a metallic retention or the physiopathologic disposition of absorbed metals, the mode of their excretion and the metabolic disturbances affecting their solubilities.

Metallic retention is the physiopathologic disposition of absorbed metals around the capillaries of the blood vascular system. While this interpretation portrays the vastness of the area for metallic retention, the actual elements concerned in this process are the connective tissue cells. These cells belong to the so-called reticulo-endothelial system and are peculiar in that they retain their embryonic characteristics throughout adult life.

At this point it is well to mention some modifying factors influencing the localization of absorbed metals. Probably the most important factor is the degree or extent of connective tissue proliferation. This can be illustrated by several examples; patients during a course of silver therapy who happen to have an injury of the exposed areas which heals by second intention will acquire a discoloration at this site first. Biospectrometrically this area shows a greater amount of silver. Another factor to be considered is the metabolic activity of various organs, which necessitates a greater density of the capillary network, thereby providing an increased area for the distribution of absorbed metals.

While these observations and many others have contributed evidential data sufficient to prove the elements concerned in the disposition of absorbed metals, a composite picture which will serve as an exemplary illustration is furnished by cases of argyria. The chemical and physical properties of silver are such that when this metal is absorbed or given intravenously, a beautiful and elective staining of the tissues occurs. Recently there have been reports in the literature describing a peculiar violaceous tint of the exposed skin in patients living in alpine regions who had received therapy with gold compounds. If a solution of gold sodium thiosulphate is exposed to artificial ultraviolet radiation, an identical color formation will result. A similar phenomenon is seen in the development of argyrosis.

While in physiopathologic retention of absorbed metals they are electively distributed by the histiocytes about the capillary system, their elimination from the body also becomes a cellular response, providing they are present as colloidal particles. The ubiquitous nature of the histiocyte, assisted by the more highly differentiated cellular elements arising from the primitive reticular cells in lymphoid and myeloid structures, as well as the circulating leukocytes of the blood, all respond to free the system of noxious agents, bacteria, foreign particles, particulate matter and colloidal metals. The avenue of escape is by diapedesis through the mucous membrane linings of the lungs, mouth, gastro-intestinal tract and genito-urinary tract.

When studying the retention of lead in cases of plumbism, samples of blood were secured for comparative data. Each biopsy specimen and the respective samples of blood were ashed in covered porcelain crucibles at 300 C. Equal amounts of ash from blood and biopsy specimens were studied spectrographically in juxtaposition under identical conditions. The blood ash in two samples was positive for lead, while the remaining samples were negative. Measurements of the density of the lead line showed a quantity less than that present in the respective biopsy specimens. After verifying these results by additional studies, we were able to conclude that a biospectrometric analysis would give an accurate index as to the status of the lead retention, whereas specimens of blood would have given false values.

The physiology of the cellular elements effecting the distribution of absorbed metals as a reciprocal of the capillary system and their mode of excretion, which has been verified by chemical, histochemical and spectrographic studies, merely serves to interpret and focalize a phase of this investigation on the rôle of lead retention in cases of nervous diseases. From our observations the distribution of lead is the same as that for other metals; i. e., it is not deposited in the bones but is distributed in the body as the capillaries are distributed. A spectrographic analysis of approximately equal amounts of brain, spinal cord and nerve trunks showed a lead line the density of which was directly proportional to the density of the lead line in the respective biopsy specimens. A biospectrometric analysis established the silver retention in these cases. An equivalent retention has been established for lead. This metal, owing to its chemical and physical properties, is histologically invisible, yet biospectrometrically there is as much lead around the capillaries and in the tissue spaces as one can so readily see in a proportionate silver retention. Having visualized the distribution and the factors influencing the localization of colloidal metals, supplemented by evidence that lead is retained as a quantitative variant, we shall now consider the metabolic changes affecting its solubility, thereby releasing ions highly toxic to protoplasm.



A review of the histories in the cases we have analyzed showed that the greater proportion of patients volunteered information which incriminated a metabolic disturbance previous to the onset of symptoms. In the histories taken at the office all of the patients recalled some metabolic disturbance that preceded the trouble. While all the factors affecting calcium metabolism are too numerous to mention, a few will serve as examples: pregnancy and lactation, alcoholic debauches, vomiting, diarrhea, constipation and reducing diets. Any fever-inducing agent, acute or chronic, due to bacterial or physical agents, likewise affects the solubility which is further accentuated by a concomitant disturbance in calcium metabolism. Any acute or chronic infectious process, irrespective of the site or severity, tends not only to mobilize colloidal metals to the point of infection but also to induce a

*A Quantitative Evaluation for Lead Retention*

Diagnosis	Num- ber of Cases	Lead in Biopsy Specimens, Gm.				
		Less Than	(+)	(++)	(+++)	(++++)
		0.000000001	0.000000001 to 0.000000001	0.000000001 to 0.000000001	0.000000001 to 0.000000001	0.000000001 to 0.000000001 Plus
Freidreich's ataxia.....	1	..	..	..	1	..
Bell's palsy.....	1	..	..	..	1	..
Chronic mercury poisoning.....	1	..	..	1	..	..
Involuntary melancholia.....	1	..	..	1	..	..
Degenerative disease of the spinal cord.....	1	..	..	..	..	1
Ascending myelitis.....	1	..	..	1	..	..
Infantile dystrophy.....	1	..	..	1	..	..
Anxiety state.....	1	..	..	..	1	..
Dermatomyositis.....	1	..	..	1	..	..
Occupational atrophy.....	2	..	..	1	1	..
Paget's disease.....	2	..	..	..	1	1
Myelopathy.....	3	..	1	..	..	2
Neoplasm of the brain.....	3	..	3	..	..	..
Vascular insult.....	4	..	..	..	..	4
Dupuytren's contracture.....	4	..	..	..	..	4
Myasthenia gravis.....	6	..	1	1	3	1
Optic neuritis.....	8	..	2	..	1	5
Hypertension.....	11	..	..	..	4	7
Amyotrophic lateral sclerosis.....	14	..	1	2	9	2
Convulsive state.....	15	..	1	3	8	3
Chronic plumbism.....	20	..	3	2	9	6
Diagnosis deferred.....	23	..	7	3	10	3
Encephalitis.....	25	..	7	2	10	6
Peripheral neuritis.....	38	..	8	8	16	6
Multiple sclerosis.....	62	..	13	5	35	9
Total*.....	249		47	31	111	60
Percentage.....			18.8	12.5	44.6	24.1

\* There were 10 cases referred from the University Hospital, department of neurology, Ann Arbor, Mich., Dr. Ray Waggoner; 15 cases from the Philadelphia Orthopedic Hospital and Infirmary for Nervous Diseases, Philadelphia, Dr. P. Q. Roche; 6 cases from the Nerve Clinic, New York Post-Graduate Medical School and Hospital, Dr. Helfand, 1 case from the New York Eye and Ear Infirmary, Dr. Key, and 1 case from Dr. Truman Boyes.

low grade toxemia. Other factors which must be considered are general and local anesthesia, surgical operations and injuries. These predisposing agents are familiar to every physician.

The accompanying table is a summary of the quantitative retention of lead in 249 cases of nervous disease. As yet we have not been able to study other elements found in biopsy specimens, such as manganese, zinc, tin and aluminum, owing to lack of time.

*Summary.*—It has been difficult for us to ascertain the quantity of lead which can be accepted as normal. Biopsy specimens from infants do not show a lead line. After 1 year of age the lead line either is absent or is visible only with a hand lens. However, children with signs and symptoms of central or peripheral involvement of the nervous system show a retention of lead of 0.075 Gm. An analysis of 100 cases of various dermatoses representative of the life decades probably furnished the most significant data. All of the persons with no com-



plaints other than the cutaneous manifestations showed a lead line, the density of which indicated a quantity of less than 0.000000001 Gm. or was normal. When a history of gradual increasing fatigue, loss of vigor, insomnia, vague pains in the muscles or joints, numbness or tingling in the extremities, irritability or loss of weight was obtained, the density of the lead line always indicated definite retention. Persons who are of the plump or overweight type rarely have retention of lead in the absence of symptoms. At present, if in the biopsy specimens the density of the lead line is less than 0.000000001 Gm., the lead retention is considered normal.

At this time an interpretation of the lead retention summarized in the table would merely exemplify a type of professional blundering. These cases, however, have given us an insight concerning the rôle of a metallic retention that has proved of the utmost clinical importance. We have classified the signs and symptoms of metallic poisoning as those of retention or excretion. The former signalizes the potential magnitude of the area for pathologic changes resulting from the effects of metallic elements. If one regards the normal physiochemical equilibrium reactions of connective tissue as one would explain a previously balanced solution in a test tube becoming unbalanced by adding an ion or ions that have altered its chemical reactions apparent as a precipitate, the biochemical effects of metallic retention are easily apprehended. An encumbrance of the normal physiochemical equilibrium reactions of the body by the absorption of extraneous metallic elements, however slight or severe, will obviously produce pathologic changes in the capillary endothelium and tissue spaces which secondarily will affect the normal functions of neighboring structures, thereby initiating all the varied signs and symptoms of a disease process.

The excretory manifestations of a metallic retention will include symptomatic and pathologic changes affecting the respiratory tract, the mouth and the gastrointestinal and the genito-urinary tract. Acute bronchitis may follow therapy with a metal compound. The metallic taste in the mouth and the gingival metal line and aphthous ulcerations are all signs of excretion. Patients with gastric ulcer have a retention of an element which awaits confirmation by additional cases. The familiar colic occurring in cases of metal poisoning is another symptom of excretion.

An answer to the question concerning the etiologic rôle of metallic retention has been a metal-free treatment and demineralization therapy. Clinical improvement following this treatment has justified a closer inquiry as to the sources of metallic intake and medication to affect their solubilities.

*Conclusions.*--1. A biospectrometric analysis not only determines the normal metallic elements present in the body but also establishes whether or not a patient has a physiopathologic retention of absorbed toxic metals. 2. From autopsy material, which included the brain, spinal cord and nerve trunks, as well as bone, liver, kidney, spleen, lung and blood vessels and other tissues, we established that the analysis of a piece of skin or connective tissue would determine the qualitative and quantitative metallic retention of the body. 3. Our findings do not confirm the accepted belief that lead is deposited in the bones but indicate that it is distributed like other metals, i.e., the distribution in the body corresponds to the distribution of the capillaries of the blood vascular system. 4. Clinical data and recent research studies have substantiated our original observation that the effects of absorbed toxic metals in the body could not be ascertained by estimating their quantitative excretion in the urine and feces. 5. Recent work has proved the fallacy of using blood or spinal fluid for determining the metallic retention by the body. 6. The effectiveness of the therapeutic and dietary regimen outlined has been verified by subsequent analyses. 7. This investigation thus far has given the physician a logical and scientific therapeutic regimen for patients heretofore either symptomatically drugged or discharged because nothing could be done for them. 8. A second biospectrometric analysis after treatment permits the correlation of clinical data and the excretion of a metallic retention. 9. A biospectrometric analysis can be reported in one hour.

## DISCUSSION

DR. COLIN K. RUSSEL (Montreal Neurological Institute, McGill University, by invitation): I think all will agree that lead causes organic lesions of the central nervous system. In acute cases lead colic occurs, and I may remind those present that French physicians say that in every case of lead colic there is lymphocytosis in the spinal fluid. The experience of my co-workers, Dr. Cone and Dr. Longstroth, and myself in Montreal corroborates that. Lead colic and wrist drop, it was said, are apt to occur in persons exposed to lead who were also addicted to the use of alcohol. In the old days potassium iodide was used to help eliminate lead, and warnings were given about its use because, with the excessive use of potassium iodide patients with lead colic showed evidences of lead encephalopathy with its convulsions and delirium. This suggests that certain agents, like alcohol and potassium iodide, tend to break down the barrier for metals, or at least for lead, between the vascular and the central nervous system; our experimental work tends to suggest the same thing. In cases of patients exposed to submaximal doses of lead there are often definite evidences of involvement of the nervous system. In children in whom the diagnosis of the existence of lead absorption can be made by roentgenograms of the long bones, there are evidences of encephalopathy with convulsions, the condition in many cases simulating tumor of the brain, meningitis, poliomyelitis, peripheral neuritis, etc.

I may refer to cases of that nature that we reported at the last meeting of the American Neurological Association, as published in the *ARCHIVES* (31:236 [Feb.] 1934). In cases 1 and 3 definite and pathologic quantities of lead were found in the central nervous system at autopsy. Since then we have observed a child with lead colic, an external squint and some papilledema. Examination of the spinal fluid showed lead; under appropriate treatment the child recovered. Five weeks later, this girl, aged 4, was readmitted to the hospital with sudden pain in the abdomen and constipation; otherwise she was in about the same condition as on discharge. She again had papilledema, with some hemorrhage. Again there was lead in the spinal fluid. This time there was also marked stippling of the red blood cells. Two days later convulsions suddenly developed, and the child went into status epilepticus. Calcium chloride was given intravenously on several occasions, but the child died. At postmortem examination the spinal fluid showed no lead. There was only a small amount of lead in the central nervous system. There was a great deal in the bones and some in the liver. It has been suggested that the calcium administered may have caused the lead to be stored in the bones.

How can these cases, these submaximal cases, be diagnosed clinically? The difficulties are great. Like Dr. Brickner I have tested some students. Eight volunteered. At the end of the day, when I have no doubt they were tired, we took specimens of their spinal fluid; 6 specimens contained lead and 3 showed more lead than was observed in fluid from persons with pathologic conditions. The difficulties are great. There are many fallacies. Lead is a common contaminant. Ordinary lumbar puncture needles contain lead, and the talcum powder that is used on the gloves before they are sterilized contains lead. Glassware must be free from lead. Chemical reagents were found to contain lead and had to be redistilled. Dr. Harwood before his untimely death developed a technic which we think is satisfactory. Before that, in connection with Professor Foster of the physics department of McGill University and Dr. Langstroth, we began to use the spectrographic method. Dr. Langstroth has improved that until now he has a method by which he can estimate not only qualitatively but quantitatively the amount of lead in the spinal fluid, and the accuracy of the method I think has been proved.

We have tried to work experimentally with dogs. We have found that after the first intravenous injection of tetra-ethyl lead there is a great amount of lead in the spinal fluid. The optimum time seems to be about from twenty-four to thirty hours after the injection. This disappears shortly, or at least almost disappears, from the spinal fluid. The second injection may raise the amount of lead

in the spinal fluid to a less extent than the first, but succeeding injections do not raise the amount of lead in the spinal fluid. It remains a minimal quantity for some time and then, as these injections are kept up, there occurs a gradual rise and the dog dies. One dog showed marked incoordination and spasticity of the extremities; mentally it was clear. Another dog died in convulsions, while another seemed to go mad and had convulsions. The first dog had had an injection of thorium dioxide and possibly the vascular system had suffered. An intravenous injection of tetra-ethyl lead caused a huge amount of lead to appear in the spinal fluid. It never disappeared but always remained at a high level. The second injection increased it, and the dog died shortly afterward. It is difficult to interpret these findings, but it appears that in the first place the system is taken, as it were, unaware and has no defense, and the lead passes into the nervous system readily. The system then develops a defense, and the barrier between the spinal fluid and the nervous system is well set to prevent the lead from passing, or some method of storing the lead is developed until that storage place is overcrowded and the lead passes through. The paper just presented suggests that there is a place of storage that we have not thought of in the perivascular tissue. I do not know that I am prepared to accept it as the only place of storage. Minot and Aub have shown that lead is stored in the liver and bones and in the lungs, dependent on how the lead was taken into the system and on various other factors. It seems to me that something of the following situation obtains: Lead can be stored; its metabolism runs parallel with that of calcium, and it is very sensitive to changes in the hydrogen ion concentration of the blood. In these dogs the changes from a positive to a practically negative content of lead in the spinal fluid would take place in a day, or two days in any case, and we have seen the same thing in patients with acidosis.

I suggest that lead may be stored in various parts of the body, in the liver and in the bones particularly and also in the connective tissue and various other tissues. It is subject to changes in the hydrogen ion concentration which mobilizes it readily and lets it loose in the blood stream. In the case of the child of whom I spoke, I meant to add that pathologically there were changes in the brain: evidences of edema, changes in the blood vessels with an edematous degeneration of the endothelium and thickening of the vascular coats with evidences of what might be interpreted as thrombus formation, at least a stasis in the vessels that was going on to organization. I wonder if it may be this agent that is causing the changes in the vascular endothelium which Dr. Tracy Putnam finds in his work.

Lead acts on the lipoid bodies, as evidenced by its action in the stippling of the red cells and on myelin sheaths. I wonder if this is the lipolytic reaction which Dr. Brickner finds in his work. We are following this up clinically, but more particularly in experimental work, and as yet we have not come to any conclusions.

DR. E. D. FRIEDMAN, New York: From the presentation of the facts this evening one would have to infer that lead is an important factor in the genesis of neural disease. I wish to say a word of caution in this regard; in a recent conversation with Dr. Goettler, pathologic chemist of the Bellevue Hospital, I found that in view of the universal use of tetra-ethyl lead gasoline and the fact that lead goes into the making of automobile tires, which during the course of the day grind out many dust particles which are laden with lead, the existence of lead in the human body is becoming very frequent. This statement seems to be borne out by some of the facts that were presented here this evening. I therefore advise caution with regard to making lead so universal an etiologic factor in neural disease.

DR. RICHARD M. BRICKNER: The results of this evening's presentations have shown that the question of multiple sclerosis is being approached from so many different angles at present that an effort to combine them, to unify them and to see if there is a common thread in them would be worth while. I do not think that one can say that a definite answer to the question of multiple sclerosis has

been given, yet so many new approaches are being made that one may be approaching it. It might be useful, if possible, to do each of the various tests that have been described this evening in as many cases of multiple sclerosis as can be collected and in that way to compare the results and see if any conclusions can be reached. I have available figures for lead obtained by the biospectrometric method described which I have not yet had a chance to correlate with the findings for esterase.

I wish to ask Dr. Steiner what theoretical conclusions can be derived from the complement-fixation test. What does it indicate from the standpoint of etiology, and what might some of the possibilities be other than a spirochetal one?

I wish to ask Dr. Putnam if he finds thrombi in parts of the body other than the nervous system? One would think that one might. Also, why does not one find many thrombi in the gray matter with degeneration of the cells?

I wish to ask Dr. Gaul what has become of the old-fashioned lead line and stippling? I do not recall having seen any lead lines or stippling in cases of lead poisoning at the Neurological Institute. Also, is there any particular type of case in which the condition is improved with demineralization? Is demineralization feasible in children?

DR. GABRIEL STEINER: In reply to Dr. Brickner, the reaction of the blood for multiple sclerosis has the same significance in that disease as the Wassermann reaction has for syphilis. The Wassermann reaction is not positive in all cases of syphilis and is rarely positive in nonsyphilitic cases. These rare positive reactions in nonsyphilitic cases are considered as nonspecific (due to a lability of the blood serum) or as uncharacteristic (in special nonsyphilitic diseases, such as acute malaria and endocarditis lenta). It is still necessary to study this reaction in a greater number of cases of nervous diseases related to multiple sclerosis. Clinically, one must differentiate between multiple sclerosis and related diseases, such as disseminated encephalomyelitis, Schilder's disease, acute myelitis, neuromyelitis optica, etc. It is possible that the new reaction can help in this direction.

DR. TRACY J. PUTNAM: To begin with Dr. Brickner's questions, I have no idea what capillaries in other parts of the body show. As far as I know, no particular studies have been made of any organs other than the brain in cases of multiple sclerosis. This is something which deserves study. In regard to the presence of thrombi and degeneration in the gray matter, this, of course, does occur occasionally. Cases of multiple sclerosis occasionally occur clinically with atrophy and involvement of the anterior horn cells of the cord and degeneration of the gray matter in the brain. It is perhaps somewhat exceptional and certainly not nearly as common as the disease of the white matter. This, I presume, is not because thrombi do not occur there but because the gray matter has a much richer blood supply and a much richer anastomosis than does the white matter.

DR. L. EDWARD GAUL: In regard to stippling, it must be remembered that stippling occurs in 1 per cent of specimens of normal blood and may be observed frequently in cases of secondary anemia, irrespective of the cause. It is also found in cases of various types of poisoning, particularly aniline poisoning. Therefore, even if stippling is present, it does not indicate that it is due to lead.

In regard to improvement from demineralization, in cases that we have analyzed in which there were definite symptomatic changes but no obvious lesions of the central nervous system the condition responded well to the demineralization treatment. I see no reason why this treatment cannot be carried out in children as well as in adults.

DR. C. BURNS CRAIG: I wish to add a word along the line of the remarks made by Dr. Friedman. All persons in New York are exposed daily to considerable amounts of lead in the city water supply, which gives a strong reaction—three +, I believe—by the biospectrometric estimation. Therefore, all have by some means either eliminated it or stored it or have an immunity to it. I think a word of caution is in order concerning lead as an etiologic factor in nervous conditions the cause of which is obscure, such as multiple sclerosis.

## Book Reviews

**Handedness, Right and Left.** By Ira S. Wile. Price, \$2.75. Pp. 357. Boston: Lothrop, Lee & Shepard Company, 1934.

Dr. Wile has divided his book into ten chapters, and has added a comprehensive bibliography, as well as a complete index of authorities and subjects. Thus, in arrangement his work is convenient and thorough, but his concepts are often startling and his generalizations unconvincing. In the first, introductory chapter, for example, he states: "Life constantly reveals two essential poles—straight and crooked, virtue and vice, wealth and poverty, strength and weakness, beginning and end, life and death. And one of these poles is right, the other wrong; and the one that is wrong is left. The right and left of life create its unity. . . . One must recall that the earth's daily movement around its axis is from west to east, hence the sun appears first in the east and last in the west. This is a significant fact and underlies much of the right-left balance in human affairs."

The second chapter deals with the hand preferences of primitive man. Wile concludes: "Primitive man had a larger measure of ambidexterity—as judged by implements which could be used by either hand. Later in man's development left handedness became more of a curiosity."

Wile continues with a discussion of philology, apparently in an effort to find a reason for the use of the terms left and right in handedness. He suggests that as language is a crystallization of ideas, therefore, "in language positive values have been given to the right and negative to the left."

In chapter 4, he makes it clear that there is great difficulty in evaluating handedness. The conclusions of the many authorities quoted vary from 1 to 30 per cent as the estimated frequency of left handedness to right handedness. This divergence seems to depend entirely on what tests or other criteria of handedness are used. In spite of this apparent inconsistency in methods, he feels justified in concluding from the estimates given that sinistrality occurs to the extent of 25 per cent and appears to be a mendelian recessive. However, he gives no conclusive evidence that such is the case. He does not define just what he includes in the term left handedness, nor does he explain which tests he considers of value in determining a dominant laterality in hand usage. He even draws conclusions about handedness in boys, girls, criminals, mental defectives and other persons, disregarding this fundamental uncertainty, which of necessity leaves the question of the frequency of right handedness and left handedness still undetermined.

In the chapter, "Theories About the Causation of Dominant Handedness," Wile cites the findings of many investigators but does not discuss the bases of their conclusions. The variety of the theories is striking. For instance, it is suggested that right handedness is due to the larger size of the left cerebral hemisphere, this resulting from the better circulation and nutrition of the part. No mention is made, however, of opposing views which indicate that there is no consistent difference in the size of the hemispheres. Another theory is that a dominant handedness is a response to the special demands in a people's culture. A contradictory theory suggests that left handedness, like right handedness, is inheritable, both having arisen spontaneously as a mutation which has become hereditary, and is therefore not an acquired characteristic. Still other authors think that the crux of the matter lies in ocular dominance, which is carried over into handedness. Thus, the right handed person is right eyed. The discussion is incomplete, however, for there is no explanation why such a person is right eyed or why some right handed people are left eyed and vice versa. Finally there is a theory dealing with the deflective force of the earth's rotation. Wile's summary of this portion of the book is characteristic of his whole method of discussing the subject of handedness. "In viewing general causation (of handedness) natural forces cannot



be ignored. The solar motion and the rotation of the earth have always been present and inescapable. Man has been subject to them whether carried on his mother's hip, back, shoulder, or arm; whether chipping flint, building pyramids or carrying ivory or jade; whether with fixed or changing habitations; whether using clubs, stones, sabres, pistols or machine guns; regardless of his race, creed, color, vocation or location. These phenomena belong to an unspeakably distant past, but no less so to the unremitting immediate present. Their effects are evident in nature, north and south of the equator, in terrestrial and celestial fields. Could man have escaped their influence upon his eyes and his ideas, his hands and his head, his rightness and his rectitude? I doubt it—for in that case he would be an exception to a principle affecting his universe."

The remainder of the book—about two hundred and fifty pages—Wile devotes to a consideration of mankind's ideas in regard to the sun and sun worship, luck, magic and religion. Much of this folklore is interesting but has no apparent relation to handedness. There is also a chapter on heliotropism, in which Wile draws an analogy between the tropisms of plants and animals in respect to the sun and the behavior of man. In conclusion, some of the psychologic reactions and behavior patterns of converted "sinistrals" and "dextrals" are mentioned briefly, but not discussed.

The book brings together the results of a very diversified study of handedness. The bibliography is full of interesting references. But in regard to the problem of dexterity or right handedness versus left handedness, the curative and diagnostic factors, the possible correlations with personality, the interesting subject of apparent ambidexterity and a full consideration of the possible consequences of the suppression of a dominant handedness, Wile's contribution is not enlightening.

**Facts and Theories of Psychoanalysis.** By Ives Hendrick, M.D. Price, \$3. Pp. 308. New York: Alfred A. Knopf, 1934.

In this book Hendrick has aimed at a comprehensive statement of observations and inductions generally agreed on by psychoanalytic workers, a statement of psychoanalytically orthodox fundamentals. The exposition is not obscured by apology. He does not attempt to popularize, but only to make clear. Thanks to the directness of his presentation, he has achieved a comprehensive statement within the compass of about three hundred pages; he has aimed rather to inform the curious than to disarm the hostile; his book forms a definite complement to such presentations as Stephen Karin's "Psychoanalysis and Medicine," or Healy and Bronner's "Structure and Meaning of Psychoanalysis"; like their works it is designed for the serious reader who has little knowledge of the subject.

The arrangement of the material is carefully reasoned. Under the first major heading, "The Facts of Psychoanalysis," he describes the phenomena of man's psychologic growth as revealed in the psychanalytic situation; he describes the material of which the patient in this special situation says, "I feel, I remember." Dreams and free association, as the two major instruments in effecting the recovery of memory, are discussed under this heading. As to the things remembered and felt, the subjects of a few of the other sections give the best summary: unconscious fantasies, bisexuality, ambivalence, sublimation, displacement, infantile psychosexuality, pregenital psychosexuality, unconscious guilt and punishment fantasies.

Under the second major heading, "The Theories of Psychoanalysis," Hendrick discusses the inductions which have been made from the "factual" observations already presented. As he observes, these inductions occupy in psychoanalysis much the same position which the atomic theory with its ramifications occupies in chemistry; they are the product of old observations and the guide to new ones; some of them at times, like the atom, assume an almost factual, experiential reality and, like the atom model, they are being constantly modified to accord with new observations. His presentation reflects these facts.

The third major heading is "Therapy by Psychoanalysis." His presentation of the psychoanalytic method is intended not as a handbook of technic but as a defini-



tion of the major phenomena which develop in the psychoanalytic situation and the major technical devices by which they are handled. Transference, resistance, interpretation and the theory of psychoanalytic therapy are given "orthodox" statement.

Under the fourth and last major heading, "The Present Status of Psychoanalysis," Hendrick discusses first the historical and executive problems of organization and education. He then gives excellent sections to Jung, Adler and Rank, whose relationships to the orthodox psychoanalytic school is a matter for constant debate.

Though Hendrick's manuscript was approved by critics already familiar with the subject, one wonders whether this is a guarantee that the book will be lucid and palatable to readers not already acquainted with the material. He presents some of his explanations with a dogmatic baldness which is sure to infuriate the rigorously logical reader. Such minor lapses from tact and apparent lapses from logic are all too familiar in psychoanalytic presentations, and it is unfortunate that a number of them should occur in the first pages of this book. An occasional "perhaps" or "it seems" makes excellent sauce for the presentation of unpalatable ideas.

**An Introduction to Sex Education.** By Winifred V. Raymond, Ph.D. Price, \$2.50. Pp. 312, with 24 illustrations. New York: Farrar & Rinehart, 1934.

Those who have been looking for a volume containing information on all phases of sex life will find this book valuable. It is the most discerning consideration of a difficult subject that has appeared in many months; delicacy and dignity are not sacrificed to frankness, nor is accuracy subordinate to social attitudes. In logical sequence the author has related several well written chapters on the biology, psychology and history of sex. The origins of modern social institutions are traced from primitive man through centuries of written history to the present. Their relations to sexual matters is made clear. Topics which are often voiced in whispers in the living room, the classroom and at the swimming hole (usually inaccurately) are discussed at length. Sexual perversions, prostitution, venereal disease and the normal sex life are handled in an informed manner, and at no time is there a suggestion that these subjects should be morbidly tabooed. The closing note—sex and society—is especially well sounded, for it presents the outlook and necessity of a personal acceptance of sexual problems by the individual before sexual aberrations can be eliminated.

At certain points in the text it seems that undue space is accorded to one or two topics, but possibly the author hopes to emphasize these by repetition. Good drawings illustrate the chapter on the biology of sex and are wisely included because of the necessary complexity of this chapter. References are given, and correlative reading is suggested. The psychiatrist may find the book useful for patients who lack information about the sexual factors which bring them under his care. It is a book that can be recommended for the college student and the general reader.

**Craniocerebrale Schemata für die roentgenographische Lokalisation.** By A. Schüller and H. Urban. Price, 5 marks. Pp. 8, with 18 illustrations. Leipzig: Franz Deuticke, 1934.

Schüller and Urban present a cleverly conceived but simple method for the localization of intracranial lesions. The procedure depends on a set of charts and two films, one taken in the anteroposterior projection and the other a profile view. The charts consist of eight drawings of craniocerebral sections, representative of coronal planes at various levels. Accompanying them is a profile view of the head on cellophane on which are outlined the various areas corresponding to these sections.

The roentgenograms are taken at a target-film distance of 150 cm.; the lateral projection is taken with the sagittal plane of the skull parallel to the cassette;

the anteroposterior film is made when a line passing through the superior orbital rim and auditory canal is perpendicular to the cassette.

After the films are made, the roentgenogram taken in the lateral position is placed over the cellophane scale. This reveals the lesion falling within a numbered section. The corresponding section is selected from the prepared charts, the anteroposterior projection is placed over it and thereby the pathologic area is located in the region of an associated structure revealed and named by the underlying drawing.

This procedure of roentgenographic localization is simple and quickly accomplished, having sufficient accuracy for practical purposes in determining the localization of intracranial foreign bodies, endocranial accumulations of air and calcifications and ossifications inside the skull. No comment is made in regard to the applicability of the method to heads of different sizes and shapes. It would seem that such variations should be considered.

**Prediction of Vocational Success.** By Edward L. Thorndike et al. Price, \$2.50. Pp. 284. New York: The Commonwealth Fund, 1934.

Thorndike and members of the Institute of Educational Research at Columbia University obtained school and test records for more than 2,000 children and followed the early vocational career of about 1,800 of these. The records and tests had some predictive power in the case of clerical occupations but practically none in the case of mechanical occupations. Psychologists, vocational counselors and employers will be interested in the report of this extensive investigation.